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BIOLOGY AND MEDICINE

355 Techniques Utilized in Inducing Conjugation in Paramecium Bursaria. C. F. Ehret. AECU-602(UAC-152), nd. 8p.

The mating responses of Paramecium bursuria the techniques used for inducing conjugation are discussed. A reaction sequence method and a reaction phase method for quantitating the mating reaction are given in detail.

356 Pulmonary Penetration of Fine Particles Administered by Intra-Tracheal Insufflation and Inhalation. George V. Taplin, James S. Grevier, and Helene Drusch. AECU-608(UCLA-23), Aug. 22, 1949. 17p.

It has been demonstrated that bacillus subtilis spores, measuring 0.3 to 1.5 μ in size, penetrate to the alveoli in rabbit lungs following administration by intratracheal insufflation and inhalation. These particles are distributed evenly throughout the pulmonary tree. More are seen in the trachea and the large bronchi after insufflation than following normal inhalation. Barium sulfate powder micropulverized by dry grinding, until 70% by number of the particles were in this same size range, was insufflated intratracheally for control purposes. Complete pulmonary penetration was demonstrable microscopically in peripheral lung sections. Also, x-ray examination of the lungs showed penetration to the fine bronchioles. 20 references.

357 Studies on the Histamine Content of Blood with Special Reference to Leukemia, Leukemoid Reactions and Leukocytoses. W. M. Valentine, M. L. Pearce, and J. S. Lawrence. AECU-609(UCLA-44), Oct. 7, 1949. 46p. Proposed for publication in Am. J. Med.

The literature concerning blood histamine has been reviewed including the evidence that the incorporation of histamine within the myeloid leukocytes may be one of the metabolic functions of myelopoiesis. Data are presented on the histamine content of blood in normal subjects and in subjects with acute leukemia, chronic myeloid leukemia, erythremia, and with leukocytoses or leukemoid reactions of other etiologies. The changing relationships of total blood histamine to unit myeloid cell histamine in subjects receiving irradiation therapy for chronic myeloid leukemia are also presented.

The data indicate that total blood histamine in chronic myeloid leukemia is usually very high in comparison to normal, that the values in erythremia show a definite but less marked tendency in the same direction, while the values in leukocytoses of other etiology are, with few exceptions, normal or low. The blood histamine per million myeloid cells is, on the average, about twice normal range in subjects with chronic myeloid leukemia, within the normal range or a little low in erythremia, and very low on the average in the group of leukocytoses studied. The suggestion is tentatively made that an aberration in this metabolic process (histamine incorporation within myeloid leukocytes) may be an inherent component of chronic myeloid leukemia whereas in physiologic leukocytoses and leukemoid reactions this is not the case.

358 The Activation of Mouse Liver Fatty Acid Oxidase. Dorothy L. Fillerup and James F. Mead. AECU-631 (UCLA-45) Oct. 25, 1949. 12p.

BIOLOGY AND MEDICINE

The conditions necessary for activation of mouse liver fatty acid oxidase have been investigated and a system developed which has been successful in laboratory experiments. Oxidation of octanoate with mouse liver homogenates was unsuccessful with techniques developed for rat-liver homogenates. Addition of manganous ion and l-malate or magnesium ion and ketoglutarate activated the system. The action of ketoglutarate, based on malonate inhibition, may be explained by its transformation into malate and its energy contribution during this transformation. Speculations on the action of manganous ion involve the function of metallic ions in enzyme action.

359 Nuclear Physics and Medicine. Gerhard Schubert. Göttingen, Muster-Schmidt, 1948(second edition). 344p. (in German).

The first part of this book deals with the general principles of nuclear physics as far as they are of interest in medical research (properties of the atom, radioactivity, and artificial transmutation of elements), as well as with the biological effects of ionizing radiation (therapeutic applications, tracer methods, genetic effects, etc.). The second, practical, part deals with the apparatus and measuring devices necessary for medical research involving nuclear physics (preparation of radioactive samples, detection of radiation, tracer technique, dosimetry). Attention is given to radiation injuries and their prevention.

360 Relationship of the Cell Surface to Metabolism. VI. Hydrolysis of Sucrose and Raffinose. Aser Rothstein and Rebecca Meier. AECD-2751, Oct. 28, 1949, Decl. Dec. 5, 1949. 10p. Proposed for publication in Science.

Uranium has been found not to inhibit the rapid hydrolysis by yeast of sucrose to glucose plus fructose, and of raffinose to fructose plus melibiose. It does prevent utilization of the products of hydrolysis and any direct utilization of the sucrose and raffinose. The hydrolytic enzymes are bound to the cell-structure and do not appear in the supernate. The quantitative recovery of the products of hydrolysis in the supernate of uranium-inhibited yeast indicates that the sucrose and raffinose-splitting enzymes are located on the surface of the cell. 10 references.

361 The Control of Atmosphere Beryllium in a Metallurgical Laboratory. Norman P. Pinto. AECU-415 (SEP-23), Aug. 24, 1949. 31p.

This report describes the facilities of a laboratory which is engaged in research and development in the powder metallurgy of beryllium. Experience with the handling of beryllium provides confidence in the safe operation of this installation. The complete ventilation system, including the supply-air distribution system, exhaust system, and hoods, is described fully and its effectiveness evaluated. The additional facilities, including respirators, clothing, showers, and cleaning methods, are discussed. The medical program for the surveillance of the health of workers is outlined.

362 Effect of Citrate Salts and Other Factors on the Distribution and Excretion of Beryllium. Jack Schubert

and Marcia R. White. AECU-640(UAC-169), July 1949. 23p.

The present study was directed toward clarifying the factors governing the metabolism of beryllium compounds, increasing their rate of elimination, and minimizing their deposition in the more susceptible organs. To accomplish these aims the chemical complexing action of the citrate anion as such and/or the displacing or carrier action of the cations of calcium, sodium, aluminum, zirconium, and thorium have been utilized experimentally. Following intraperitoneal injection of Be^7-chloride into rats, urinary excretion of Be was about 13.6% of the injected dose during the first 24 hr and subsequently fell to about 0.5% each day. Twelve days after injection 40% had been excreted, 18% was in the skeleton, and the rest was in the soft tissues. However, following intraperitoneal injection of Be^7 as the citrate complex, 40% of the injected dose was found in the first 24-hr urine. At 8 days all but ~ 10% of the injected dose had either been excreted or deposited in the skeleton. The distribution of Be^7-chloride differed markedly with the route of administration. After intraperitoneal injection into rats, the pancreas contained 15% of the injected dose; but after intravenous injection, none. There was none in the pancreas but much more retained in the skeleton, liver, and spleen. Two months after intravenous injection of Be^7-citrate the urinary excretion of Be^7 by an adult dog was about 0.05% of the injected dose a day and the fecal excretion about 0.005%. Most of the retained Be^7 was in the skeleton, particularly in the long bones. The administration of sodium or zirconium citrate to rats 2 hr after the injection of Be^7-chloride increased the urinary excretion of Be^7 by 2 1/2 fold during the next 24 hr. After sodium citrate the Be^7 concentration in the liver, spleen, and kidney was reduced significantly. Neither citrate, given 6 days later, affected Be^7-chloride metabolism. Calcium gluconate and the citrates of Na, Al, Zr, and Th given to the Be^7-citrate injected rats had no effect on the distribution or excretion of Be. The results obtained were interpreted by a consideration of the chemical properties of beryllium. 19 references.

363 Radioelement Metabolism and Approaches to the Treatment of Radioelement Poisoning. Jack Schubert. AECU-641(UAC-170), nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

When radioactive elements enter the body they constitute a form of poisoning since they emit ionizing radiations. A study of radioelement metabolism involves the questions of where these substances go in the body, how fast they get there, and how rapidly they leave. One of the problems of radioelement poisoning is how to shift the deposits of radioactive materials to less radiosensitive tissues, or how to expedite their removal from the body.

A reasonable attack upon the above questions can be made by considering the chemical and colloidal properties of the radioelements in the physiologic environment. As a result it is possible to predict the characteristic metabolic behavior of the radioelements in general, and to evaluate the efficacy of possible therapeutic procedures.

Of particular interest is the metabolism of such elements as plutonium, thorium, yttrium, and strontium, and the treatment of radioelement poisoning by means of zirconium and other metals, as well as by complexing agents such as citrates.

364 The Applications of Stable and Radioactive Isotopes in Biochemistry. Friedrich Weygand. Angew. Chem. 61, 285-97(1949) July (in German).

A general review is given of the application of stable and radioactive isotopes in biochemical investigations. Topics discussed are: dilution analysis, the tracing of chemical compounds and reactions (particularly metabolic reactions and biosyntheses), and the choice of suitable isotopes. The properties of a large number of isotopes of various elements are described, as well as tracer techniques for organic compounds. An extensive bibliography is given, containing 200 items and covering the period from 1923 to 1948.

365 Biochemical and Physiological Differentiation During Morphogenesis. IX. The Extracellular and Intracellular Phases of the Liver and Cerebral Cortex of the Fetal Guinea Pig as Estimated from Distribution of Chloride and Radiosodium. Louis B. Flexner and Josefa B. Flexner. J. Cellular Comp. Physiol. 34, 115-27(1949) Aug.

The chloride and sodium contents of the liver, cerebral cortex, and serum in the developing fetal guinea pig were determined through the use of Na^{22}; the extracellular and intracellular spaces were then estimated. The Na^{22} was injected into the mother animal 48-72 hr before the fetus was removed; samples of the heart blood were taken from the fetus (while still attached to the placenta) and the mother; samples of fetal liver are cerebral cortex were also obtained. The method of estimating the radioactivity of the samples is described. It was shown that there is a decrease of 40% in the weight of the extracellular phase of the cerebral cortex from the 40th day of gestation to term; the corresponding increase in weight of the cellular stage is analyzed in terms of weight change of the nerve cell bodies per unit weight of cortex and the change in weight of the nerve processes, plus the glia. The weight of the hepatic cells per unit of liver increases 20% from the 33rd day to term. Evidence is also presented that the neurones of the cortex become selectively permeable to sodium at about the 45th day of gestation, when there is a correlated series of sharply defined morphologic and biochemical changes. 16 references.

366 The Dispersion of P^{32} and Other Tracers Injected into Embryonated Eggs. R. M. Taylor and A. C. Saenz. J. Immunol. 63, 319-30(1949) Nov.

A study was made of the manner, degree, and rapidity of dispersion of noninfectious or inert material in solution or in suspensions when introduced into normal, 10-13 day chick embryos; soluble and insoluble P^{32}, Evans' blue and suspended charcoal were investigated. It was found that when the Evans' blue and suspended charcoal were inoculated into the amniotic sac, they rapidly appeared in the gastro-intes-

tinal tract; none was detected in the respiratory tract. Suspended radioactive chromic phosphate inoculated into the amniotic sac rapidly appeared in the gastro-intestinal tract, but in the 13-day-old embryos a small amount reached the lungs. Soluble P^{32} inoculated into the amniotic sac dispersed rapidly in the allantoic fluid, the blood, and the body of the embryo, while soluble P^{32} inoculated into the allantoic sac tended to remain in this position. Soluble P^{32} inoculated into the yolk sac soon appeared in the blood and the body of the embryo and to a lesser degree in the allantoic fluid, while none was found in the amniotic fluid; soluble P^{32} injected intravenously was found in highest concentration in the blood and in the body of the embryo, but a considerable amount appeared in the allantoic fluid in contrast to a negligible amount in the amniotic fluid.

367 The Distribution of Radioactive Arsenic in the Organs of Poisoned Insect Larvae. F. O. Morrison and W. F. Oliver. Can. J. Research 27, 265-9(1949) Oct.
Radioactive arsenic trioxide (0.104 g), containing As^{76} (8 mc/g) injected in solution into the hemolymph of last instar Tenebrio molitor L. larvae, distributed itself throughout the hemolymph, body wall, fore-, mid-, and hindgut, and Malpighian tubules within 1 hr and showed little change in distribution after as much as 20 hr even though most larvae remained alive; when injected into the gut it showed little sign of escaping. Fifty instar Phlegethontius quinoquemaculata Haw. larvae fed the dry active arsenic trioxide absorbed only very small amounts; the largest portion remained in the gut if the specimen died, or was eliminated within 20 hr if the specimen lived; as little as 10^{-11} g arsenic was detectable in the digested insect organs. It is concluded that the use of a dipping counter on aliquots of the acid tissue digest provides a simple and accurate means of counting samples.

368 The Effect of Influenza Virus Infection upon the Dispersion of P^{32} in Embryonated Eggs. A. C. Saenz and R. M. Taylor. J. Immunol. 63, 331-5(1949) Nov.
This paper discusses the effect of the influenza virus upon the dispersion of P^{32} when both substances are inoculated into the allantoic sac of 11-day chick embryos. A solution of P^{32} in the form of Na_2HPO_4 and diluted so that 0.1 ml would register 100,000 - 200,000 counts upon a Geiger counter was used; an equal amount of this solution and a dilute solution of the virus were mixed and injected in 0.2 ml quantity. It was found that both types A and B of the influenza virus caused an increase in the amount of P^{32} escaping from the allantoic fluid and a greater concentration of the isotope in the blood. The authors explain this observation on the basis of increased permeability to the isotope through damage to the chorioallantoic membrane by the virus.

369 Location of Radioactive Penicillin in Staphylococcus Aureus After Contact with the Drug. P. D. Cooper, D. Rowley, and I. M. Dawson. Nature 164, 842-3(1949) Nov. 12. (Letter to the editor).
An experiment to determine whether radioactive penicillin (labeled with S^{35}) after being taken up by Staphylococcus

aureus (SS II St. Mary's strain) is present in the cytoplasm of the bacteria or attached to the cell walls is described. The method used for the separation of the cytoplasm from the cell walls consisted of shaking a solution of the bacteria with glass beads and rupturing the cells, thus allowing the cytoplasm to flow out. On centrifugation, the cytoplasm could be separated from cell walls and intact cells. Sensitive staphylococci were washed twice before and after standing for 30 min in a 0.1 cc/ml solution of radioactive penicillin. The extraction method was then employed and the two fractions were assayed for radioactivity. If the penicillin reacted directly with the transport enzymes only, it would be expected that radioactivity would be found in the cell walls. It was determined that the proportion of total radioactivity of the system found in the supernatant fraction compared exactly with the proportion of bacteria disrupted (as calculated from electron micrographs). It is concluded that all of the penicillin taken up by the bacteria is concentrated in the cytoplasm.

370 The Metabolism of Uric Acid in the Normal and Gouty Human Studied with the Aid of Isotopic Uric Acid. Jean D. Benedict, Peter H. Forsham, and DeWitt Stetten. J. Biol. Chem. 181, 183-93(1949) Nov.
Isotopic (N^{15}) uric acid was administered in a single intravenous injection to three normal and two gouty subjects maintained on a low purine diet, and the isotope concentration of the urinary uric acid was followed for a time thereafter. Analysis of the results obtained from the normal subjects revealed that the injected uric acid was promptly diluted by a miscible pool of uric acid containing about 1,200 mg. The rate of formation of uric acid was calculated from the rate of fall of isotope concentration and was found to exceed the rate of urinary excretion of uric acid by 20% or more. In the gouty subjects studied, the miscible pool of body uric acid was found to be up to 15 times larger than in the normal, so large as to require that a portion of the solid phase urates, joint deposits and tophi, be included in this pool. Evidence is presented for the view that a portion of uric acid undergoes catabolic breakdown in man. 19 references.

371 Methods of Using Radioisotopes in Chemical and Biological Research. Ed. Dechambre. Rev. sci. gen. 61, 168-76(1949)(in French).
Geiger counters, ionization chambers, and photographic plates are discussed as the most important methods of detection. The isotopes may be obtained by slow or fast neutron bombardment, or by the use of the cyclotron. Possible neutron sources, including piles, are discussed and the procedure for obtaining isotopes from available sources is described. The author concludes with a section on the choice of appropriate isotopes for various purposes.

372 On the Intake of Radioactive Phosphorus, $_{15}P^{32}$ by Colibacteria. Gustav-Adolf Kausche and Heinrich Haardick. Z. Naturforsch. 3b, 433-7(1948) Nov.-Dec. (in German).

In a food solution containing a little phosphorus, tagged with P^{32}, colibacteria ingest 35% of the offered P^{32}, the intake being proportional to their rate of growth. The ingested phosphates are to a large extent bound organically, since only up to 3.5% can be removed by dialysis.

373 Some Aspects of the Metabolism of Hydroxyproline, Studied with the Aid of Isotopic Nitrogen. Marjorie R. Stetten. J. Biol. Chem. 181, 31-7(1949) Nov.

The problem of the metabolic interconversions of the amino acids ornithine, proline, hydroxyproline, glutamic acid, aspartic acid, and arginine was investigated through the use of hydroxyproline labeled with N^{15} (29.5 at. %). The hydroxyproline was fractionated into its two DL forms and some of the hydroxy-DL-proline was added to the stock diet fed to two rats for three days. The largest part of the isotope was recovered in the urine, the urea and NH_3 having high concentrations; a small amount of the isotope was also found in the body proteins, glutamic acid, aspartic acid and arginine containing more than in proline. It is concluded that most of the body hydroxyproline is derived from the oxidation of proline rather than from dietary hydroxyproline. 25 references.

374 Studies on the Incorporation of Injected Cytochrome c into Tissue Cells. I. Injection of Non-Radioactive Cytochrome c into Rats Previously Given Radioiron. Helmut Beinert and Kurt R. Reissmann. J. Biol. Chem. 181, 367-78(1949) Nov.

Seven weanling rats were made anemic by being fed an iron-deficient diet and bled at frequent intervals. These rats were then injected subcutaneously and intraperitoneally with radioiron for about 12 weeks; an approximate total dose of radioiron corresponding to 55 times 10^5 counts/min was injected into each animal. The right kidneys of two litter mate pairs were removed, washed and frozen, and 16 hr later one litter mate from each pair was injected through the tail vein with 4 mg of cytochrome in saline solution. Immediately thereafter, both members of each pair were subjected to a pressure equivalent to that at 20,000 ft in the course of 30 min and kept at that pressure for 3 and 24 hr, respectively. Twenty-four hours after the cytochrome injection, the animals were decapitated and the remaining kidneys, hearts, and samples of skeletal muscle were removed and frozen. The tissues were analyzed by the method of Rosenthal and Drabkin (J. Biol. Chem. 149, 437(1943)) and that of Carruthers (J. Biol. Chem. 171, 641(1947)). A 305% increase in the cytochrome level was found 0.5 hr after the injection and a 75% increase after 2.5 hr in the kidney. 29 references.

375 Synthesis of Isoprenoid Compounds in Plants. James Bonner. J. Chem. Education 26, 628-31(1949) Dec.

A report is given of experiments using radioactive carbon in which attempts were made to discover the nature of the 5-carbon branch chain compound which is a precursor of rubber in plants. Guayule plants which may contain 20% or more of their total dry weight in the form of rubber were studied. Preliminary work showed that acetate might probably effect rubber formation in the guayule plant, and the possibility that betamethylcrotonic acid might arise as a product of acetate and acetone condensation was considered. Acetate containing radioactive C^{14} in both carbon atoms was supplied to seedlings or to mature plants; it was found that within three days a considerable portion of the acetate given had appeared in the rubber fraction, and that the rubber, prepared as the several times recrystallized rubber tetrabromide, contained radioactivity at a higher level (up to 75% of the acetate) than the tissue as a whole. In a further experiment the plants were fed with radioactive acetate and after a three day period the plants were harvested and an appropriate procedure used for obtaining the organic fraction which should contain betamethylcrotonic acid. To this fraction then was added a large amount of inactive betamethylcrotonic acid. This material was recrystallized from the extract and found to contain radioactivity. Such radioactivity could have been attained only in the presence of radioactive betamethylcrotonic acid in the plant extract. The experimental results suggest strongly that acetate is an intermediate in rubber synthesis and that acetate may be metabolized to betamethylcrotonic acid, as a further intermediate in the process.

BIOLOGY AND MEDICINE

376 The Utilization In Vitro of C^{14}-Labeled Acetate and Pyruvate by Diaphragm Muscle of Rat. Claude A. Villee and A. Baird Hastings. J. Biol. Chem. 181, 131-9(1949) Nov.

In the experiments reported here, the effect of insulin on the metabolism of C^{14}-labeled acetate and pyruvate to carbon dioxide was studied in vitro in the diaphragm muscles of adrenalectomized diabetic and normal rats. The radioactivities of the labeled acetate and pyruvate were determined by their combustion to CO_2 and subsequent collection as $BaCO_3$; it was found that the acetate had an activity of 3,110 counts/min/mg, and the pyruvate an activity of 1,465 counts/min/mg. The isolated hemidiaphragms were incubated in Warburg vessels in a medium of Na_2HPO_4, $MgCl_2$, NaCl and either the acetate or the pyruvate. It was found that the amount of acetate and pyruvate metabolized in muscle from diabetic rats was less than that from normal muscle; insulin returned the pyruvate metabolism to normal but not the acetate; neither normal metabolism was affected by an insulin addition. Adrenalectomy produced an increase in the fraction of the total pyruvate utilized and a decrease in the accumulation of lactate. The effects of the addition of certain intermediates in the Krebs tricarboxylic acid cycle on the acetate and pyruvate metabolisms were also studied. 20 references.

377 Biological Studies of Radiation Effects. Effects of Total Body X-irradiation on Blood Coagulation in the Rabbit. (Preliminary study). Robert L. Rosenthal and Agnes L. Benedek. AECU-592(UCRL-414), nd. 7p.

Following exposure to single doses of total body x-irradiation ranging from 200-1000 r, rabbits show a coagulation impairment characterized by a thrombocytopenia, diminished clot retraction increased clotting time of recalcified plasma,

and increased clotting times after the addition of either heparin or toluidine blue. These changes can be attributed chiefly to the diminished platelet count and function. No free or excess heparin could be demonstrated in the blood following radiation, as evidenced by the lack of significant prolongation of clotting time and the negative toluidine blue titration test. The rabbit, in contrast to the dog and guinea pig, shows an inconspicuous hemorrhagic response following x-ray exposure. The importance of species differences in the clotting and hemostatic mechanism and its response to x-irradiation and other agents is suggested.

378 Further Studies on the Modification of Sensitivity to X-rays by Cysteine. I. Time Course of the Protection and Comparison of Certain Related Substances. H. M. Patt, D. E. Smith, E. B. Tyree, and R. L. Straube. AECU-599(UAC-148), nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Cysteine (950 mg/kg, neutralized I.V.) greatly reduces sensitivity of rats to total-body x-irradiation (800 r, 250 kv), provided that the amino acid is given before the exposure. Comparable protection is obtained when cysteine is administered intravenously immediately or 1 hr before irradiation (87% survival of 79 cysteine irradiated; 16% survival of 82 irradiated controls). Injection immediately after exposure or 6 or 24 hr before is without influence. Oral cysteine (1900 mg/kg) affords a significant protection when given 30-60 min prior to x-irradiation. However, oral administration is not as efficient as intravenous. Cystine, unlike its reduced counterpart, cysteine, is not effective by either route. Glutathione, on the other hand, can reduce x-ray toxicity but only when it is given intravenously before exposure. Oral glutathione does not protect rats or mice even though the oral dose is equivalent to the effective oral dose of cysteine in sylfhydryl content. Methionine, ascorbic acid, and sodium sulfide do not alter survival after lethal x-irradiation. Results with colloidal sulfur are equivocal and further work is necessary. These findings suggest first that the critical reactions leading to morbidity are complete when the irradiation is terminated and that these reactions are apparently not reversible. Secondly, a sulfhydryl group distinguishes the substances which can protect from those which cannot. It is important to bear in mind, however, that all sulfhydryl-containing materials may not necessarily protect and that other reducing substances which are properly distributed, temporally and spatially, may.

379 Further Studies on the Modification of Sensitivity to X-rays by Cysteine. II. X-ray-Cysteine Dosage Relationships. D. E. Smith, H. M. Patt, E. B. Tyree, and R. L. Straube. AECU-600(UAC-149), nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

The purpose of this work was to determine the quantitative aspects of the protective action of cysteine against x-irradiation. Sprague-Dawley rats were injected with neutralized cysteine (dosage range 350-950 mg/kg) immediately before

total-body irradiation with 250 kv x-rays (dosage range 600-1600 r). Animals were irradiated in pairs, one rat having been injected via the tail vein with cysteine and the other with an equivalent volume of a 5% NaCl solution. Survival at 30 days post-irradiation was the criterion for cysteine protection. At an x-ray dosage of 800 r (killing an average of 80% of the controls) and cysteine dosages of 350, 475, 575, 675, and 950 mg/kg the number of animals protected by cysteine was roughly proportional to the cysteine dosage. Experiments employing cysteine dosages of 475 or 950 mg/kg and irradiations of 600, 700, 800, 1000, 1200, 1400, and 1600 r revealed: (1) Above 800 r cysteine protection decreased as the amount of irradiation was increased. (2) Above 800 r the higher cysteine dosage afforded 13-20% greater protection than the lower one. (3) 2.9 - 4.75 mg/kg of cysteine were required to protect against each r above the just sublethal dosage. (4) The LD_{50} x-ray dosage was raised from 725 r for the controls to about 1060 r and 1220 r by the low and high cysteine dosages, respectively.

380 Studies on the Absorption and Distribution of Vitamin A in X-irradiated Rats. R. L. Bennett, Vera C. Bennett, Alpha Shaver, and Theresa Grachus. AECU-604(UR-90), Aug. 25, 1949.

The absorption of vitamin A alcohol by young female rats at varying intervals during the first week following 625 r whole body radiation has been studied 6 and 10 hr after a test dose of vitamin A. Absorption after a 6-hr test was slightly less in irradiated than control animals during the first 24 hr post-irradiation. From the 1st to the 6th day post-irradiation the irradiated rats showed an increased absorption. After a 10 hr test, absorption by the irradiated animals was 6 to 8% less than in control animals. The diminished absorption occurred during the first 6 days post-irradiation. Liver content of vitamin A in the irradiated animals was diminished after both 6 and 10 hr experiments. The carcass values were increased in the irradiated animals at the end of 6 hr, but returned to control values by 10 hr. Adrenal content of vitamin A, on the other hand, was less in the irradiated than the control rats at 6 hr and was increased above control rats at 10 hr. 15 references.

381 On the Modification of the Toxicity of X-rays by Immunization. Henry I. Kohn. AECU-610(ORNL-386), Oct. 27, 1949. 9p.

Following injection with sheep erythrocytes, the Sprague-Dawley and Osborn-Mendel strains of rat showed a rise of about 50-75 r in the LD-50% of 250 kv x-rays. The Holtzman strain showed a fall of about 25 r. The injection of sheep cells prevented the rise in albumin-globulin ratio which invariably occurs after irradiation in nonimmunized rats.

382 Effect of X-irradiation on Thyroid Function in Rats. John B. Hursh, Jack B. Mohney, and Priscilla A. Van Valkenburg. AECU-615(UR-89), Aug. 24, 1949. 29p.

Rats were irradiated with x-rays applied locally to the thyroid area at total dose levels of 1000, 3000, and 6000 r. Thy-

roid function of these irradiated rats was tested by injecting I^{131} at a number of post radiation times, sacrificing the animals 4 hr after injection, and analyzing the excised thyroid gland for uptake of I^{131}, as well as the percentage I^{131} bound in an undialyzable complex. Histological sections of the thyroids were prepared and examined. No functional or morphological changes could be demonstrated in the 1000-r rats. In the 3000-r and 6000-r rats the iodine uptake was greater than in the control rats and the increase was greater with higher x-ray doses and with longer post radiation intervals within the limits investigated. In spite of the increased iodine uptake, no morphological changes of the thyroids could be found at these dose levels on the basis of examination of the random sections prepared. The increased uptake is tentatively regarded as an indirect consequence of a systemic response to radiation. The level of local x-irradiation necessary to produce destruction of thyroid tissue was found to be greater than the highest dose (about 5000 r delivered as a single dose) which can be administered to a rat without causing death of the animal. 11 references.

383 The Immediate and Delayed Morphological Effects of X-radiations on Meiotic Chromosomes. Roberts Rugh. AECU-649(CUF-3), Nov. 1, 1949. 20p.

The mitotic and meiotic stages in spermatogenesis of the Japanese fire salamander, Triturus pyrrhogaster, were studied immediately and after an interval of 48 hr following x-irradiation at 5,000 r and 50,000 r. The chromosomes of this salamander are among the largest known and, since spermatogenesis is a rather continuous cyclic process, it is possible to observe the effect of x-irradiation on chromosomes at various stages of their synthesis. X-irradiation immediately affects the formed chromosomes in that it makes them less viscous, more fluid, and sticky. Their fluid nature is seen in the fact that they tend to flow out along the attached spindle fibers, losing their identity in shape. Their sticky nature is seen in the fact that the chromosomes become clumpe together. The spindle fibers are normally very difficult to locate and identify, but following x-irradiation and the Feulgen test for thymonucleic acid, they are heavily stainable due to the fact that they are coated by the very fluid chromosomal material to which they are attached. The chromosomes, once formed, seem to show movement, even following x-irradiation, because the end point of the post-irradiation damage in most cells is the pycnotic nucleus. This is most frequently seen in the secondary spermatocytes. There is no evidence that chromosomes, x-irradiated to 5,000 r or more, ever return to the pre-meiotic or non-discrete phase. Stages in spermatogenesis which show no formed chromosomes at the time of irradiation show some fragmentation of the linin network, but this is difficult to quantitate or evaluate. It is the contention of this author that since the intermitotic stages never enter mitosis, following x-irradiation to 5,000 r or more, that they must also be radiosensitive, as are the mitotic (e.g., metaphase) stages, and that the criterion of visible chromosome damage is not exclusive evidence that the non-discrete phases in chromosome synthesis are not also radio-sensitive.

384 Applied Biophysics, Survey of Physical Methods Used in Medicine. A Symposium. N. Howard-Jones, Ed. Brooklyn, N. Y., Brooklyn Chemical Publishing Co., Inc., 1949. 293p.

The following topics are treated which relate to the applications of physics to medicine: biophysical factors in drug action; survey of the applications of electronics in medicine; chemical applications of heat; mechanics of brain injuries; biological effects of penetrating radiations; comparative studies of the biological effects of x-rays, neutrons and other ionizing radiations; genetic effects of radiations; actions of radiations on viruses and bacteria; quantitative histological analysis of radiation effects in human carcinomata; measurement of radiation; total energy absorption in radiotherapy; technical methods in x-ray therapy; technical methods in radium therapy; million-volt therapy; protective methods in radiology.

385 The Effect of Oxygen on the Frequency of X-ray Induced Chromosomal Rearrangements in Tradescantia Microspores. Norman H. Giles, Jr., and Herbert Parkes Riley. Proc. Natl. Acad. Sci. U.S. 35, 640-6(1949) Nov.

Comparative exposures of Tradescantia paludosa to x-rays were made in air, helium, argon, nitrogen and oxygen, and observations were made on chromosomal changes (interchanges and interstitial deletions) at the first postmeiotic mitosis in the microspores by means of acetocarmine smear preparations at the fourth or fifth day after irradiation. The x-ray source was a Coolidge self-rectifying tube with a tungsten target and operated at 250 kv; the filtration was 3 mm Al plus added filtration through a 0.25 in. lucite exposure chamber, and the dosage rate was usually 45 r/min. Total doses of 90, 180, 270 or 360 r were given. It was found that the frequency of aberrations was strikingly reduced when nitrogen replaced air and increased when oxygen replaced air as the medium; the number of aberrations in the oxygen medium was five times that in the nitrogen medium; aberration frequencies were also reduced in additional exposures in other gases such as helium and argon. The availability of oxygen is considered an important factor in the production of chromosomal changes by irradiation.

386 Hereditary Effects Produced in Maize by Radiations from the Bikini Atomic Bomb. I. Studies on Seedlings and Pollen of the Exposed Generation. E. G. Anderson, A. E. Longley, C. H. Li, and K. L. Retherford. Genetics 34, 639-46(1949) Nov. (See also NSA 1-1246).

This report deals with the immediate generation of plants grown from five lots of maize seed exposed to atomic radiation, and includes observations on the effects shown in the seedling stage and observations and analyses of the effects shown in the pollen stage; the lots were compared with lots exposed to 5,000 r, 10,000 r, 15,000 r, and 20,000 r of x-radiations. Bikini Lot A showed effects slightly less than those observed in the 15,000 r lot; the effects on the Bikini Lot were, however, more uniform. The percentages of central spikes of the tassels of the plants showing one or more sectors of partially sterile pollen were 4.0 - 63.1% for the Bikini series, and 29.5 - 70.4% for the x-ray series. It is estimated that there were between two and three partially sterile sectors per plant of average size of about two

branches in the Bikini Lot A. It is concluded that the data indicate that cell competition in the growth of the apical meristem eliminates the more affected cells, thus modifying the dosage frequency relations in the plants.

387 Mechanical and Thermal Injury from the Atomic Bomb. Herman E. Pearse and J. Thomas Payne. New Engl. J. Med. 241, 647-53(1949) Oct. 27 (See also NSA 3-1320).

A description is given of the incidence and varieties of traumatic and thermal injury from the atomic bomb and the results of the clinical production of flash burns. The components of the atomic bomb flash were: a temperature of over 4,000°C; transmission largely by radiation; a spectrum high in ultraviolet, infrared and in visible light and brilliancy; and, a duration of less than a second. Shadow burning, the production of keloids, contracture and ulceration are described and correlated with the distance from the radiation source, the degree of protection afforded by clothing and other shelter, and the incidence of radiation sickness and traumatic injuries. The flash produced by magnesium was used to produce a flash burn similar in characteristics to the atomic radiation burns; extremely high intensity of radiation, short duration (0.1 sec) and other criteria were satisfied. It was noted that clinically there was an abrupt and diagrammatic demarcation between the burned and normal skin; the normal, basophilic cells changed on a straight line into acidophilic, burned cells. In the dermis the demarcation was at the burn border in the crypts and hair follicles. The method of healing of this type of burn was unusual; the burn consisted of a coagulative, fixed type of necrosis in the epidermis and dermis, with eschar formation and subsequent sequestration, rather than the organization seen in the noncoagulative, necrotic tissue of the moderate temperature burn. With a flash burn of moderate severity the epithelium grew out from normal borders and hair follicles and the healing was rapid; with widespread radiation injury and destruction of the epithelium in the crypts and hair follicles, delayed repair due to the lack of epithilial islands occurred. Prevention of infection and adequate shelter and diet are suggested as methods of treating these burns. 11 references.

388 Morphological Aspects of the Regeneration of Nerves Sectioned and Subjected to the Action of X-rays. Gildo Gastaldi. Rivista Sperimentale di Freniatria 73, 5-41(1949) June 30 (in Italian).

The repeated irradiation of the peripheral nerves by x-rays offered in the present studies an approach to the general problem of the action of x-radiation on traumatic lesions of the nerves. The research was conducted on 30 rabbits and on 6 guinea pigs, half of each group serving as controls. The local irradiation (80 r/session, for a total dose of 160-720 r, with a filtration of 0.5 mm Cu plus 2 mm Al, and 170 kv and 30 cm target distance) began immediately after the hemisection of the sciatic nerve and continued on the following days; the animals were sacrificed in pairs in stages from the second to the 19th day after the nerve sectioning. In 14 of the 30 rabbits, a vital coloration state (by successive injections of a 5% solution of trypan blue intravenously) was produced; the animals were treated each day before the sectioning and continued to receive injections of the dye for variable periods afterwards. Several observations are reported: an initial state of active hyperemia with capillary dilitation and a focal miliary diapedesis occurred on the second or third day after sectioning; a slight proliferation of blood vessel walls occurred on the sixth day; other phenomena such as accentuated fibrotic metamorphosis of granulsoa tissue, traumatic degeneration, accentuated leucocyte migration, accentuated phagocytic activity, and prolonged disorientation of young nerve fibers also occurred; there was, however, no appreciable difference in the contents of the cells of Schwann. 12 references.

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389 Physiological Effects of Radiation; Extent of Damage to Living Tissue. Franklin Hutchinson. Yale Sci. Mag. 24, 9-10, 18, 28, 30(1949) Nov.

A general discussion is presented on the hazards and dangers of radiation; the ionization effects on mutation and malignant and normal tissues are outlined, and the types of radiation are described. It is concluded that all types of radiation can be highly dangerous, and the less radiation, the better.

390 Preliminary Studies of the Effectiveness of Local Irradiation in the Induction of Lymphoid Tumors in Mice. Henry S. Kaplan. J. Natl. Cancer Inst. 10, 267-70(1949) Oct.

In order to test the theory that incident radiation acts locally and directly upon the cell or tissue to produce alterations in the cellular behavior manifested as tumorous growth, the three experiments described here were performed. In the first experiment, strain A mice were immobilized and irradiated over one of four dorsal regions through a circular portal of 1 cm in diameter; the radiations were 600 - 750 r. The second experiment consisted of the irradiation of mice of the C57 strain by a single dose of 1000 r, delivered to a transverse body section 4 mm in thickness. In the third experiment, 1000 r was delivered in 5 daily treatments in 2 consecutive weeks to mice of the strain C57; some of the mice were treated over the entire upper half of the body, and others over the entire lower half. The results show that the induction of the lymphoid tumors occurred without significant frequency and indicate that their production is, the authors state, probably not solely the result of a simple direct action of radiation upon the susceptible cell or tissue of origin.

391 Production of Radioactivity in Animal Tissues by High-energy X-rays. W. V. Mayneord, J. H. Martin, and D. A. Layne. Nature 164, 728-30(1949) Oct. 29.

Experiments are presented which determine the amount of induced radioactivity that it is possible to produce by irradiating rat tissues with x-rays, and the factors involved are outlined; an assessment is made of the biological significance of such a phenomenon. A full-grown dead rat was placed in the beam of an x-ray, usually at a target distance of 1 m, and the rat was irradiated with a dosage rate of 0.5-1.0 r/min for 5-90 min. After exposure, the animal was removed and its activity was measured with a calibrated, thin-walled counter coupled to a conventional scaling circuit. It was found that the induced activity decays rapidly at first with a half-life of the order of 2 min, leaving a longer-lived component. At 17 Mev the activity is very small, but counting

rates twice that of the background were noted; at 21 Mev the activity is considerable, and at 24 Mev the activity is 50% more than that of the 21 Mev tests. The half-life curve suggests the formation of carbon and oxygen isotopes; from the data given it is possible the calculate the rates of absorption of energy in tissue either directly from the x-ray beam or from the disintegrations in the tissues. It is concluded from the study of the energy absorption rates that the production of radioactive isotopes does not seem to explain the biological effects of x-rays on tissues.

392 Radiation—Its Biological Effects and Problems. J. R. Martin. Mech. Eng. 71, 893-8(1949) Nov.

Radiation characteristics, radiation effects on normal cell processes, units of radiation, and such radiation problems as external and internal hazards are discussed in this article; precautionary measures such as protective clothing, pocket ionization chambers, film badges, and other monitoring means are described. Two types of ionizing radiation reactions are noted: chemical changes involving destruction of the cells due to strong radiations; and, changes of some degree in the genetic balance of the cells. Some factors of importance when considering the general effect of mitotic interference are: the biological significance of the cells affected; the number of cells affected; the severity of the chromosome damage; and, the density of the ionization path. Background irradiation and the properties of the different types of radiation are outlined; shielding, air contamination, and waste disposal are briefly covered, and their importance is indicated.

393 Radiobiological Experiments on Drosophila Pupae, Using Fast Electrons and X-rays. Wolfgang Dittrich, Wolfgang Paul, Gotthold Salz, and Gerhard Schubert. Z. Naturforsch. 4b, 226-9(1949) Aug.-Sept. (in German).

Pupae of Drosophila melanogaster, 12-24 hr old, were irradiated with 4-Mev electrons, and their mortality rate was determined as a function of dosage. Parallel experiments were carried out with x-rays (180 kev, 0.25 mm Cu). The 50% lethal dose for fast electrons was found to be somewhat larger than that for x-rays but the difference is smaller than the uncertainty in the absolute value of the dose. The observed "formal" most probable number of hits is smaller for fast electrons than for x-rays. The magnitude of the "formal" target region is given.

394 Studies Concerning the Egg-white Bodies of the Bone Marrow. IV. Report: The Changes in the Egg-white Fraction of the Bone Marrow after Roentgen Irradiation. Yutaka Nihei. Tohoku J. Exp. Med. 49, 233-8 (1948) Oct. 11 (in German).

Five healthy dogs were irradiated on one side of the thigh with 4,000 r of x-rays; 72 hr later the animals were sacrificed; from the femurs, both the irradiated and the nonirradiated, the bone marrow was extracted and the egg-white fraction was studied. The radiations were administered by a 180-kv machine with filtration of 0.5 mm Al and 0.8 mm Cu

and at a target distance of 20 cm; the radiation field was 100 cm^2 and the radiation rate was 38.8 r/min. It was found that in the plasma the total nitrogen (T-N) dropped, the residual nitrogen (R-N) increased and the egg-white nitrogen (Ew-N) dropped considerably; the albumin and the globulin took absolute and relative drops, while the fibrinogen increased. The marrow from the irradiated areas showed R-N, Ew-N, and T-N decreases; the albumin showed absolute and relative decreases, the globulins, an absolute drop and a relative increase, and the fibrinogen an absolute increase without a relative change. In the bone marrow of the nonirradiated femurs, there was no change in the R-N and the T-N, but an important decrease in the Ew-N, which was reflected in the absolute and relative drop in albumin-N and an absolute decrease and relative increase in globulin and fibrinogen-N. It is concluded that large doses of x-rays seriously injure the egg-white bodies; a cleavage begins, so that in the plasma there is an increase in R-N and a decrease in the egg-white fraction.

395 Survival Curves of Haploid and Diploid Yeasts Submitted to X-rays. Raymond Latarjet and Boris Ephrussi. Compt. rend. 229, 306-8(1949) July 25 (in French).

Several investigators have noted the sigmoidal shape of the survival curve of yeasts submitted to ionizing radiations. One of the present authors has obtained such a curve and interpreted it as due to a "two-hit" process (Ann. Inst. Pasteur 70, 277(1944)); subsequently, by using highly ionizing radiations, he has shown that in these two hits two distinct targets were involved (Frilley and Latarjet, Compt. rend. 218, 480(1944)). It seemed probable that these results might be a consequence of a diploid nature of the yeasts employed. To test this hypothesis, haploid and diploid cultures, derived from the same strain of Saccharomices Cerevisiae, received various doses of x-rays, at 33 kv, the intensity at the level of the preparation being 4,000-8,000 r/min. The lesions were observed and counted microscopically after 20 hr incubation at 25°. The lesions of haploid yeasts are all irreversible, while those of the diploids, besides irreversible cases, show frequent cases of restoration and of further reproduction of colonies. The corresponding survival curves, viz., a sigmoid graph for the diploid organisms and a simple exponential curve for the haploids, confirm well the above stated hypothesis. From the slopes of the curves, the targets could be determined as spheres of 33-38 m radius. The real significance of these facts is unknown; death, due to chromosomal lesions, of a diploid cell seems to be related to the appearance either of two recessive lethal mutations, or of a single dominant one; the sigmoid curve may result as a combination of these two processes.

396 X-ray Effects in Fruit Trees. I. Granhall, A. Gustafsson, Fr. Nilsson, and E. J. Oldén. Hereditas 35, 269-79(1949).

Radiation dosages of 500-25,000 r were administered to the scions of several varieties of apples, pears, and sweet cherries in order to study the lethality of x-rays and to determine the possibility of inducing favorable mutations by means

of the radiations. The scions were grafted on parent plants and observed for growth and other characteristics. At 10,000 r none of the pears and apples survived; the cherries suffered a similar fate at 5,000 r. The ideal dose for the pears and apples appeared to be 5,000 r at which abnormalities appeared without excessive mortality; 2,500 r was the optimum dosage for the cherries. The most typical primary effects were bifurcations of shoots and leaf midribs; other effects, such as change in color and shape of the fruit also occurred. It is concluded that since the apparent effect of the x-radiations is to increase the probability of occurrence of abnormalities ordinarily seen in the fruit (changes in size, shape, and color), that this is a method for the possible production of better fruit of increased size, flavor, resistance to disease and other desirable qualities.

397 Atomic Energy in Clinical Medicine. Henry J. Klaunberg. Gen. Practice Clinics 6, 435-92(1949) Sept., Oct.

The first part of this extended report on atomic radiation covers such topics as the effects of radiation (damage to tissues and organs, radiation illness, and burns), mechanisms of genetics and heredity and an analysis of the effects of radiation as related to population, area and method of delivery; protection means are also discussed under the headings of radioactive waste disposal and health physics. In the second part, the isotope program is discussed from the viewpoints of tracer research, investigations utilizing isotopes for diagnosis and treatment, and the specialized cancer and agriculture programs; other related programs are briefly described.

398 The Contribution of Therapeutics in Irradiation Sickness. J. A. Salvá and M. Badell. Med. Clinica 13, 30-3(1949) July (in Spanish).

Six cases of irradiation sickness caused after anterior irradiation are presented, and the effects of Phenergan on the relief of the radiation sickness syndrome are noted. The Phenergan was administered orally once a day in doses of up to 25 mg; complete radiation protection was afforded by the Phenergan for the radiation doses noted; it was also found that Phenergan was of greater value in the treatment of irradiation sickness than the classical medications and the other antihistamines.

399 Beta Track Autoradiography Using Carbon 14. George Boyd and Hilde Levi. AECU-616(UR-91), Sept. 26, 1949. 10p.

Alpha particles, whose energies and ionizing potentials are much higher than those of β particles, give well-defined, straight tracks of developed silver grains in nuclear track emulsions. Photographic manufacturers have now developed emulsions which show tracks of β particles approaching an energy of 1 Mev. These emulsions have been so sensitive that long exposures of histological specimens containing a low concentration of, for example, C^{14}, lead to unsatisfactory results. This is due to an accumulation of a large background of tracks from cosmic events. The Eastman Kodak Research Laboratory has recently made an emulsion of intermediate sensitivity which has registered C^{14} β tracks beneath a tissue section in considerable excess of the background tracks. These emulsions also enable following the track of the β particle to its point of entry. Two experimental NTB emulsions on glass plates, No. 416,297, 100 μ and No. 417,104, 25 μ thick, were prepared to have a sensitivity such that they would register as a track only β particles up to approximately 0.4 Mev. It is this feature that makes possible the registration of C^{14} β particles with a maximum energy of 0.165 Mev without registering an undue amount of random ionization. The liver section of a rat injected with glycine labeled with C^{14} in its alpha carbon atom was studied by use of these emulsions. The tissue was fixed in Bouin's solution, embedded in paraffin, and cut at approximately 7μ. A tissue section was floated on water and picked up by slipping the photographic plate beneath it in the water and lifting the tissue out on the emulsion. After partial drying, the plate was placed in a black plastic slide-box and set aside in a cold room at approximately 7°C for exposure. Several grams of a dessicant ($CaCl_2$) were placed in the box to keep the humidity low in order to delay decay of latent images. After exposure and removal of the paraffin, the plates were developed in Eastman D19 for 20 minutes and fixed in 30% hypo at approximately 23°C. The tissue was stained in hematoxylin and eosin and mounted in the conventional manner. The C^{14} activity of the liver was determined by means of an ionization chamber and the results compared with the number of tracks counted in the emulsions. The various factors to be taken into account when analyzing the autoradiographs are discussed as follows: background, self-absorption, geometry, latent image fading, and failure to count low-energy β particles.

400 The Effect of Preoperative Roentgen-Ray Therapy on Arterial Hypertension in Embryoma (Kidney). J. Edmund Bradley and Miles E. Drake. J. Pediat. 35, 710-14(1949) Dec.

The effects of pre-operative roentgen therapy in ten cases of hypertension due to Wilm's tumor are presented. The radiation therapy consisted of total doses of 1,212-2,872 r; the operations consisted of nephrectomy or laparotomy in each case. One patient is living eight years later and another five and half years later with hypertension within normal limits; the others died. The tumor response was initially negligible or evidenced a reduction in size in the cases; four cases showed a drop in hypertension level five to eight days after the beginning of the treatments.

401 The Function of Various Types of Thyroid Carcinoma as Revealed by the Radioautographic Demonstration of Radioactive Iodine (I^{131}). Patrick J. Fitzgerald and Frank W. Foote, Jr. J. Clin. Endocrinol. 9, 1153-70 (1949) Nov.

The results of the administration of I^{131} in 100 consecutive cases of carcinoma of the thyroid are presented; the cases were studied through the radioautographic technique. In 89 of the cases, tracer doses of the isotope (0.3-0.5 mc of I^{131}) were given 24-48 hr before surgical biopsy of the lesion; nine patients received therapeutic doses of 27-250 mc 2-10 days before operation; two patients received 10 mc for investigative purposes. Patients given the smallest amounts

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showed positive radioautographs, while patients with larger amounts gave negative results. There were 32 cases in which the radioautograph showed higher concentration in the normal tissue than in the carcinoma tissue; the histologic pattern of the tumor appeared to have a significant bearing on the concentration of iodine. It is concluded that the uneven, variable concentration of the isotope in normal and neoplastic tissue emphasizes the difficulty in calculating adequate therapeutic doses.

402 Radioactive Iodine, I-131, in the Treatment of Hyperthyroidism. Sidney C. Werner, Edith H. Quimby, and Charlotte Schmidt. Am. J. Med. 7, 731-40(1949) Dec. (See also NSA 1-1329; 1-1934; and 3-277).

The results of the treatment of 103 cases of toxic goiter with I^{131} are presented. The dosages of the isotope were 3 - 6.5 mc; the method used and the calculation of the degree of irradiation are outlined. The results are analyzed in terms of the number of treatments, the total dosage per treatment, the dosage per estimated gram of thyroid tissue and the irradiation received by the gland; the results show that about 92% of all the patients were relieved of their hyperthyroidism. It is concluded that: the use of radioiodine therapy in primary, previously unoperated, goiter should be restricted to the older age groups; and, I^{131} therapy is the method of choice in treating recurrent toxic goiter, when hyperthyroidism reappears after surgery. Such complications as hypothyroidism, thyroiditis, tracheitis, and laryngitis, parathyroid tetany, exophthalmos, transient exacerbation of toxicity and heart failure are discussed in connection with the I^{131} therapy. 35 references.

403 Radioiodine Therapy of Metastases from Carcinoma of the Thyroid: A Six-Year Progress Report. S. M. Seidlin, I. Rossman, E. Oshry, and E. Siegel. J. Clin. Endocrinol. 9, 1122-37(1949) Nov.

Twelve patients of a group of 30 with metastatic carcinoma of the thyroid were treated with 200-1,000 mc of I^{131} or I^{130} over periods of two months to six years. Of these patients, seven are still living after six years, three greatly improved, two moderately improved and two in a stationary condition; of the five patients who are dead, three showed initial improvement and two, who were admitted in terminal stages, showed no improvement. In the cases which showed no initial radioiodine uptake, this condition was induced through injections of thyrotropic hormone or thyroidectomy. In one case, skull metastases were observed six years after therapy and found to be necrosed with no evidence of viable tumor tissue; the necrotic tissue from the tumor could, however, still concentrate radioiodine.

404 A 30-Million Volt Synchrotron for Medical Use. Anon. Nature 164, 726-8(1949) Oct. 29.

The 30-million volt electron-synchotron described here consists essentially of a large alternating-current magnet, with a mode of action similar to that of a high-tension transformer; the electrons are fed from an electron gun into an evacuated glass annulus where they are held in an orbit and

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accelerated. This arrangement is used only for the initial acceleration up to 4 Mev; an electric acceleration field varying in synchronism with the rotating electrons adds the final impetus, and consists of a quarter-wave radiofrequency resonator formed in the shape of a hollow cylinder, through which the electrons pass. Investigations will be made concerning the biological effects of the rays produced by this machine.

405 The Treatment of Metastatic Thyroid Cancer with Radioactive Iodine: Credits and Debits. J. B. Trunnell, L. D. Marinelli, B. J. Duffy, Jr., Ruth Hill, Wendell Peacock, and Rulon W. Rawson. J. Clin. Endocrinol. 9, 1138-52(1949) Nov.

Twenty-five patients with thyroid carcinoma metastases in the pulmonary or skeletal regions were treated with I^{131}; of these patients, only one had metastases which initially concentrated a therapeutic dose of the isotope; the other patients were first subjected to thyroidectomy or other procedures to increase the I^{131} uptake. The clinical results reported here are based on nine cases which received intensive treatment with I^{131}; the total cumulative doses administered to these patients were 144-906 mc; the largest single quantity given was 315 mc. At the present time, all nine of the patients have viable cancer, but four have shown definite improvement through the therapy, as evidenced by decreased tumor masses or tumor destruction. Some toxic effects which were observed during and after the therapy are amenorrhea, depression of hematopoiesis and hyperthyroidism with elevated serum precipitable iodine.

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406 Meeting of the Chemical Society at Oxford and London. March 28-30, 1949. Angew. Chem. 61, 414-16(1949) Oct. (in German).

Abstracts are given of the following papers presented at the meeting, which was sponsored by the Chemical Department of the Atomic Energy Research Establishment; Chemistry of the transuranic elements, R. E. Connick. The position of the cis- and transuranic elements in the periodic system, M. Haissinsky. The lower valences of thorium, J. S. Anderson and R. W. M. D'Eye. Protoactinium, A. G. Maddock and G. L. Miles. A new valence of protoactinium, G. Bouissieres and M. Haissinsky. The emanation method, O. Hahn. Hydrolysis of uranyl salts, J. Sutton. Ion association in uranyl sulphate and uranyl nitrate solutions, R. H. Betts and R. K. Michels. The activity coefficient of uranyl nitrate in the presence of other nitrates, J. F. Duncan, E. Glueckauf, H. A. C. McKay, and A. R. Mathieson. Persistence of complexes of uranyl nitrate with ketones and ethers, A. R. Mathieson. New experiments on the cathodic separation of radio-elements, M. Haissinsky and A. Coche. Production of radio-isotopes, A. W. Kenny and W. T. Spragg. Isotopes of the rare earths poor in neutrons, G. Wilkinson. Production of carrier-free organic radio-halogenides, E. Glueckauf, R. P. Jacobi and G. P. Kitt. Microsynthesis of some C^{14} compounds, W. J. Arrol. Separation of Br^{82} from irradiated $NaBrO_3$, E. Berne. Production of strong Fe^{59} samples in the Gleep, A. W. Kenny

and W. R. Maton. Backscattering of electrons, L. Yaffe. The chemical properties of sulphur from irradiated KCl, U. Croatto, and A. G. Maddock. Yield of a Szilard-Chalmers reaction with fast and slow neutrons, E. Broda. Extension of our knowledge about α emitters, G. Wilkinson. The production of some important radioactive nuclei with the cyclotron, J. W. Irvine, Jr. Nuclear reaction with particles of high energy, G. Wilkinson. Compounds of tertiary phosphines with uranium halogenides, F. G. Mann and J. A. C. Allison. Oxides of uranium, K. B. Alberman and J. S. Anderson. A new micro-chemical method of detecting the presence of uranium, T. V. Arden, F. H. Burstall and R. P. Linstead. Quantitative determination of uranium in poor ores by measurement of the activity of UX, K. E. Zimens. Determination of radon and radium in water, R. B. Jacobi. Radio-isotopes available commercially, H. Seligman. Use of radioactive isotopes for the investigation of ion diffusion in aqueous solutions, J. S. Anderson and K. Saddington. Electron exchange between Co^{II} and Co^{III}, W. B. Lewis, C. D. Coryell, and J. W. Irvin, Jr. The diffusion of Ag and Hg in Ag_2HgI_4, K. E. Zimens, M. Hillert, and G. Johansson. Diffusion in solids, R. Lindner. The technique of radioactivity measurements, G. B. Cook, J. F. Duncan, and A. W. Kenny. Radioactive halogens and substitution reactions, E. D. Hughes. Investigations using radioactive penicillin, S. Rowlands, D. Rowley, and E. Lester Smith. Radioactive indicators in anti-sera, F. D. S. Butement. Investigations about the intake of fertilizers containing radioactive phosphorus, J. W. T. Spinks and G. Dion. Chemical problems in work with methyl-bromide tagged with Br^{82} and used for fumigation, F. P. W. Winteringham.

407 On Certain Properties of Beryllium Fluoride in Solutions. Part II. I. V. Tananaev and E. N. Deĭchman. Izvestiya Akad. Nauk S.S.S.R., Otd. Khim. Nauk, No. 2, 144-51(1949) (in Russian).

It has been established in the previous work (Izvest. Akad. Nauk S.S.S.R., Otd. Khim. Nauk 6, 591(1947)) that beryllium ions Be^{++} and fluorine ions F^- form several weakly dissociating compounds BeF^+, BeF_2, BeF_3^-, and $BeF_4^=$. They are written here in the order of decreasing stability, determined from measurements of hydrogen ion concentrations in the systems BeF_2-HF-H_2O, $BeCl_2$-HF-H_2O, and others. In the present paper experiments are described in which various solutions of the readily soluble and dissociation $Be(NO_3)_2$ are brought together with difficultly soluble fluorides; by measuring the increased solubility of the latter, conclusions are reached as to the formation of weakly dissociated combinations of Be^{++} and F^-. The systems studied were $Be(NO_3)_2$-CaF_2-H_2O, $Be(NO_3)_2$-PbFCl-H_2O, and $Be(NO_3)_2$-LiF-H_2O. The following two were found to be stable weakly-dissociating products of interaction: BeF^+ and BeF_2, whose dissociation constants are, respectively, 5.1×10^{-3} and 0.01. The complex ions BeF_3^- and $BeF_4^=$ are unstable.

408 Low Activity Hoods. J. P. FitzPatrick, N. G. Bohlin, and S. S. Gold. AECU-617(ANL-4336), May 20, 1949. 9p.

A hood is being developed to replace existing low-activity hoods for work involving α and soft β radiation. The 2 experimental models described here provide better ventilation, visibility, ease of decontamination, and greater convenience to the operator when setting up or running an experiment.

409 The Enzymatic Degradation of Ribonucleic Acid by Crystalline Ribonuclease. C. E. Carter and W. E. Cohn. AECU-614(ORNL-489), Nov. 2, 1949. 11p. (See also NSA 3-1663).

The products of the enzymatic separation of yeast ribonucleic acid by crystalline ribonuclease have been analyzed by ion exchange and paper chromatography. The mononucleotide product is almost exclusively uridylic and cytidylic acids in approximately equal amounts. The small quantity of adenylic and guanylic acids appearing as mononucleotides seems to arise from higher molecular weight compounds during the analytical separation on the ion-exchange resin. Several discrete fractions, which were bound more strongly to the anion exchanger than are mononucleotides, were analyzed and each was found to have a different polynucleotide composition. These latter fractions may be artifacts resulting from the analytical procedure, or polynucleotide subgroups arising from the action of nuclease on nucleic acid, or degradation products of such polynucleotides.

410 Determination of Chemical Purity. I. W. Hughes and G. T. Young. Nature 164, 503(1949) Sept. 17 (Letter to the editor).

The fact that the solubility of a pure substance is independent of the amount of excess solute has been used as a criterion of the homogeneity of proteins (Kunitz and Northrop, J. Gen. Physiol. 13, 781(1930); Butler, ibid 24, 189(1940)) and of amino-acids (Dunn et al, J. Biol. Chem 144, 487(1942)). If the solute is pure the vapor pressure a saturated solution is independent of the amount of excess solute. Otherwise this is not true. It was found that, for substances of relatively low atomic weight, a sensitive measure of purity can be obtained by comparing the vapor pressures of two solutions, one containing a large excess of solute, the other containing only a small excess. A recrystallized sample of L-glutamic acid hydrochloride contained sufficient impurity to show a difference in vapor pressure of 6 mm. By using synthetic samples of known composition the per cent of impurity may be determined. Data are also given for other substances, the apparatus is described and the limitations of the method are mentioned.

411 Preparation of Alkannin and Naphthazarin; for use as Reagents for Beryllium. T. Y. Toribara and A. L. Underwood. Anal. Chem. 21, 1352-6(1949) Nov.

Alkannin and naphthazarin were shown by Underwood and Neuman (Anal. Chem. 21, 1345(1949)) to be equivalent reagents for the microdetermination of beryllium. Alkannin (a substituted naphthazarin), which forms only a small fraction of the colored matter extractable from alkanet root (Alkanna tinctoria), was shown to be the only constituent active with beryllium. The bulk of the colored material appears to be a polymer of alkannin, and evidence indicates a dimer. The isolation procedure for alkannin was thoroughly studied.

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The difficulties in obtaining large amounts of alkannin made it desirable to find a reagent that could be more readily procured. Naphthazarin was synthesized according to the method of Zahn and Ochwat (Ann. 462, 81(1928)), but the purification procedure was modified. The synthetic method was found to be much simpler than extraction from the root. Absorption spectra of the compounds alone in carbon tetrachloride and at several pH's in aqueous medium, with and without beryllium, were determined.

412 Submerged Bulbet Methods in Microchemistry. Leonard K. Nash. Anal. Chem. 21, 1405-10(1949) Nov.

An improved method is presented for the microdetermination of molecular weights based on a measurement of vapor pressure lowering that occurs when a known weight of the test substance is dissolved in a known weight of solvent at the latter's boiling point. The method is based on a method described by the author (Anal. Chem. 19, 799(1947)), but has been simplified considerably; in particular, by eliminating entirely the use of a comparison tube and interpolation. By these changes it is possible to achieve a generalized apparatus and technique applicable to a variety of microdeterminations. In most instances the determinations are accurate to approximately 2% and the observed values do not vary appreciably with concentration. Applications of the method include measurement of vapor pressure, measurement of decomposition pressures of solids, phase studies, determination of solubility, and purity determination.

413 Chemical Procedures Used in Bombardment Work at Berkeley. Addendum No. 1. W.W. Meinke. AECD-2750, 1949, Decl. Dec. 2, 1949. 18p. (See also AECD-2738).

This is an addendum to AECU-2738. Additional procedures for chemical separations from targets bombarded with high energy particles are given in detail. The elements considered include Bi, Ra, Ac, Th, Pa, and U.

414 The Preparation of Hafnium-free Zirconium. Robert S. Hansen and Keith Gunnar. AECU-603, nd. 2p.

A new, simple, and effective means of preparing hafnium-free zirconium has been developed using silica gel which strongly and preferentially adsorbs hafnium compounds from a Zr-Hf compound mixture in certain organic solvents. Hafnium in zirconium may be reduced to less than 0.1% by passing a 1:5 solution of the chlorides in methanol through a silica gel column. 290 g silica gel will furnish 60 g purified oxide; the column can be stripped with 1M anhydrous HCl in methanol and re-used.

415 The Separation of Sodium and of Potassium by Means of Organic Ion Exchangers. Georges Kayas. Compt. rend. 228, 1002-3(1949) Mar. 21 (in French).

The separation of alkaline metals by means of ion exchangers has already been treated by Cohn and Kohn (J. Am. Chem. Soc. 70, 1986(1948)), who succeeded in separating Na, K, Rb, and Cs almost completely. Sodium and potassium have been separated by the author in a slightly different way. A solution of KCl and NaCl was adsorbed in Amberlite IR 100. The sodium was marked with Na^{22} produced by irradiating Mg in a cyclotron. The compound $HClO_4$ was used as an eluent, and the resulting solution passed through a tube wrapped around a Geiger counter. The percentage of potassium was determined spectroscopically. A plot of activity against volume of element is given.

416 Relative Yields of Ions Produced by α-Particles in Air and Water Vapour. R. K. Appleyard. Nature 164, 838(1949) Nov. 12 (Letter to the editor).

In continuation (Nature 163, 526(1949)) of the examination of the radiological properties of water, the yield of ion-pairs in water vapor under the action of α particles has been compared with the yield in air. A sector-shaped parallel-plate ionization chamber containing either water vapor at 95°C or air has been exposed to a semi-collimated beam of 5.0-Mev α particles derived from a polonium source. From several determinations of the relative yield of ions, the energy expenditure per ion pair for water vapor has been determined as 30.5 ± 0.8 ev using the value for 5-Mev α particles in air of 34.7 ± 0.5 ev. (Alder et al, Helv. Phys. Acta 20, 234(1947))

417 Studies in the Systems Inorganic Salt-water-Organic Solvent. II. Spectrophotometric Investigation of Cobaltous Nitrate. Leonard I. Katzin and Elizabeth Gebert. AECU-598(UAC-143), nd. 21p.

Spectrophotometric measurements have been made on cobalt nitrate in various solvents in an effort to explain the spectacular color changes of some cobalt salts. The explanation presented is based on two points: (1) the postulate that the Co(II) atom maintains a six-coordinate condition, and (2) competition between the electron donor "bases," water, nitrate ion, and oxygenated organic solvent for positions in the coordination sphere. In dry organic solvents with dielectric constants of the order of 20 undissociated $Co(NO_3)_2$ is formed. Absorption of this cobaltous nitrate complex gives a magenta color. The blue tinge seems to be due mainly to intensification of the normal cobalt absorption and a broadening of the peak toward longer wavelengths. The visual color of the solution should not, therefore, be used as a measure of complexing or lack of complexing. It is also shown that the complexing-hydration views of the color changes are not independent. The color behavior of cobalt perchlorate in organic solvents parallels that of the nitrate.

418 Effect of Constituent Materials upon Spectrographic Measurement of Seven Impurity Elements. M. C. Bachelder. Anal. Chem. 21, 1366-9(1949) Nov.

Inorganic powder samples weighing 350 μ/g were burned to completion in a direct current arc and the effects of constituent elements upon the spectrographic measurement of the seven impurity elements, tin, vanadium, beryllium, cadmium, cobalt, antimony, and manganese were studied. 4 tables.

419 Synthesis of Radioactive Stilbamidine Diisethionate (Stilbene-4,4'-Dicarboxamidine-C^{14} Diisethionate).

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James C. Reid. AECU-586(UCRL-465), Sept. 29, 1949. 9p.

Stilbamidine diisethionate (stilbene-4,4'-dicarboxamidine diisethionate) labeled with carbon 14 in the amidine groups has been prepared from isotopic sodium cyanide. The method employed consists of the conversion of 4,4'-dibromostilbene to dinitrilostilbene followed by the conversion of the dinitrile to the diamidine.

420 Micro-Synthesis with Tracer Elements. XI. The Synthesis of Thiourea Labeled with S^{35}. C. Wayne Bills and Anthony R. Ronzio. AECU-619(LADC-725), nd. 4p.

The sulfur isotope, S^{35}, as obtained from the Atomic Energy Commission, is in the form of barium sulfide in 0.05N barium hydroxide solution. The quantitative precipitation of the sulfur was accomplished by first transferring the solution into a 40-ml centrifuge cone, the tip of which had been drawn down to a diameter of about 7 mm and a length of about 30 mm, then adding an excess of a solution which was 0.05N in hydrochloric acid and 0.1N in cadmium chloride. The quantity of reagent should be sufficient to neutralize all the barium hydroxide and give an acidic reaction to the mixture. The sulfur was thus precipitated as cadmium sulfide. The precipitate was separated by centrifuging and decanting off the clear solution. After washing with water several times and centrifuging, the precipitate was dried while still in the cone. The quantitative conversion of cadmium sulfide to hydrogen sulfide without the introduction of other gases was accomplished by breaking off the tip of the cone containing the cadmium sulfide into a 200-ml flask into which had been introduced 20 g of metaphosphoric acid. First evacuating the system, then heating the acid to boiling while still in a vacuum, smoothly freed the sulfur as H_2S. The gas was dried through tubes containing $CaCl_2$ and P_2O_5, respectively, and then condensed in a bulb cooled with liquid nitrogen. Cadmium sulfide, 71.9 mg, containing 8.2% of CdS^{35}, by this procedure gave 17.8 mg of hydrogen sulfide (105% of theory). In a series of six experimental runs using cold cadmium sulfide the average yield of hydrogen sulfide was 95.4% with a lowest yield of 90.7%. The standard synthesis of thiourea using hydrogen sulfide utilizes an excess of this gas. Since in this instance the hydrogen sulfide is the limiting factor, the procedure was modified in such a manner as to utilize completely all of the hydrogen sulfide containing the radioactive isotope. The procedure used is based on the method described by Heuser (U. S. Pat. #1,991,852(1935)). A 10-ml flat-bottomed reaction flask containing a magnetic stirrer, 0.8 ml of distilled water, 25 mg cyanamide, and one small drop of concentrated ammonium hydroxide was used. The contents of this flask were frozen with liquid nitrogen, vacuum was established, and the H_2S previously condensed was transferred to the flask. The reaction chamber was warmed to 40°C and the contents stirred continuously for 24 hr. The solution was colored a very faint yellow but the color disappeared and a faint cloudiness appeared after 6 hr. At the end of the 24-hr period the contents of the flask were transferred into a vacuum sublimator using alcohol. All solvent was removed by evaporation and the thiourea was sublimed in a vacuum at a temperature of 70-90°. A higher temperature causes the sublimation of impurities which lower the melting point of the thiourea. Since films of oils or waxes materially raise the temperature of sublimation, it was found advantageous to remove all oil films by washing the residues first with petroleum ether, then removing the ether and dissolving the thiourea in ethanol. The solvent was then removed by evaporation and the residue was sublimed in a vacuum. The isolation of thiourea by this method is quantitative. The urea obtained, 35 mg (92.2% of the theoretical yield), melted at 171-3°. The compound possessed an activity of .535 mc/mg.

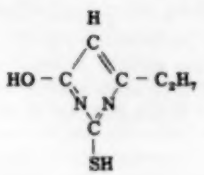
421 Micro-Synthesis with Tracer Elements. X. The Synthesis of 6-Propylthiouracil. Arthur Murray, III, and Anthony R. Ronzio. AECU-621(LADC-726), nd. 3p.

The document is not an abstract; it is reproduced below in its entirety.

The class of compounds containing oxygen atoms attached to the pyrimidine ring exerts a strong physiological effect on living organisms.

A number of hydroxy pyrimidine compounds in which an oxygen has been replaced by a sulfur atom possess a striking effect upon the thyroid gland. The physiological effect of these sulfur containing compounds is manifest by a severe hypothyroidism brought about by the exhaustion of the thyroid producing function of the gland, the exact mechanism of which at present is not thoroughly understood.

The compound best suited for a study of this phenomena is 6-propylthiouracil and is the compound selected for labeling with C^{14}. The structure of this compound is shown below.



Experimental

Into a 15-ml round-bottomed flask was placed 2.75 ml of absolute alcohol (freshly distilled from magnesium ethoxide) in which had been dissolved 0.0421 g of sodium (1.84 mM). The concentration of sodium was checked by titration of an aliquot portion of the solution.

The reaction flask was then attached to a reflux condenser, the outlet of which was connected to a guard tube filled with "Ascarite" and "Drierite." Ethyl beta-ketocaproate (0.175 ml, 1.05 mM) was added through the condenser. After thorough mixing, this was followed by a solution of 0.0666 g (0.875 mM) of thiourea (the thiourea used was a mixture of 35.5 mg of compound labeled with C^{14} and 31.1 mg of inert thiourea) dissolved in 2.5 ml of absolute alcohol. The whole apparatus was then so arranged that the reaction mixture was continuously shaken mechanically while being heated in an oil bath. Heating was maintained for 12-hr at a temperature of 85°. A colorless precipitate appeared within 10 min which settled out of the solution. The mixture was

allowed to stand 5 hr longer; then the solvent was removed by evaporation under a gentle stream of air.

The residue was dissolved in 20 ml of 3% potassium hydroxide solution and then was extracted for 6 hr with ether. The ether extract was evaporated to dryness for testing. The residue was mildly radioactive. The raffinate was made strongly acidic with sulfuric acid. A colorless, flocculent precipitate formed. The entire mixture was transferred to an extractor then extracted with ether for 6 hr. The solvent was removed from the extract by evaporation. The residue, in the form of colorless needles, was dried in a vacuum. The weight of crude product was 0.1081 g (72.8% of theory). The compound was purified by dissolving in 5.5 ml of boiling water and cooling in an ice bath. The yield at this stage was 0.0851 g melting at 205-210°. Since this melting point is somewhat low, the product was further purified by dissolving in methanol, treating with decolorizing carbon, and evaporating the solution in a sublimator. After complete removal of the solvent, the compound was sublimed in a vacuum. The final yield was 0.0778 g (52.3% of theory).

Discussion

In basic solution, all compounds containing the sulfhydryl group, -SH, or a potential sulfhydryl group such as a thio ketone possessing a hydrogen on an alpha carbon, undergo loss of the sulfhydryl group by the replacement of sulfur by oxygen.

In the synthesis here described, the loss of sulfur may take place either before or after the condensation. Regardless of when this exchange occurs, the final product of this side reaction will be 6-propyluracil because the urea formed would also condense with the ethyl-3-ketocaproate.

Since 6-propylthiouracil and 6-propyluracil are so closely related, separation by the methods used may be incomplete. This may explain the low melting points obtained. At any rate, the suggestion is here made that the compound be tested for purity by the paper chromatograph method before being used experimentally.

422 The Synthesis of Codeine Labeled in the 3-Methoxy Group with C^{14}. F. N. Chang, J. F. Oneto, Peter P. T. Sah, B. M. Tolbert, and H. Rapoport. AECU-622 (UCRL-428), Oct. 19, 1949. 10p.

With pure morphine-N-oxide as the starting material, methylation was carried out successfully with methyl-C^{14}-iodide. The codeine-N-oxide obtained was reduced by sulfur dioxide to codeine. After purification, the free base was converted to both codeine-C^{14}-sulfate and codeine-C^{14}-hydrochloride with U.S.P. specifications. The combined yield on a 20-mmole scale was 63% based on methyl iodide. Preparation of the various reagents is described. 13 references.

423 Applications of Radioactive and Stable Isotopes. R. Fleischmann. Angew. Chem. 61, 277-85(1949) July. (in German).

In a general review of the subject, the basic principles of the use of radioactive and stable isotopes are discussed. The properties and production of such isotopes is described.

Their applications are reviewed with special reference to the following topics: effects of radiation, detection of chemical elements by nuclear processes, utilization of the separability of isotopes, geologic age determination, and release of energy in nuclear processes.

424 Exchange Reactions between Cerium (III) and Cerium (IV) and between Iron (II) and Iron (III). Victor J. Linnenbom and Arthur C. Wahl. J. Am. Chem. Soc. 71, 2589-2590(1949) July (Letter to the editor).

The exchange reaction between cerium (III) and cerium (IV) in perchloric acid and in sulfuric acid solutions was studied. Ce^{141} (half-life 30 days) was used as a tracer. Electrical migation methods were used to separate partially the reactants. In sulfuric acid solutions cerium (IV) migrated toward the anode, cerium (III) towards the cathode. In perchloric acid solutions both ions migrated toward the cathode, cerium (III) being the more mobile. Samples enriched in each ion were collected. The enrichment factors (R/R_o) achieved were 1.5 to 50 and <0.01 for sulfuric acid solutions and 1.2 to 1.4 and 0.6 to 0.9 for perchloric acid solutions. Within the estimated accuracy of the experiments (5 to 20%, depending on the enrichment acieved) complete exchange occurred in all runs during the separation time (45 to 90 min for sulfuric acid solutions, 2.5 to 4 hr for perchloric acid solutions).

425 Investigation of Possible Interactions between Thallium (I) and Thallium (III) in solution and in the Crystalline Thallium Sesqui-Halides. Harden Mc Connell and Norman Davidson. J. Am. Chem. Soc. 71, 3845-7(1949) Nov. (Note)

Since the rate of radioactive exchange between Tl(I) and Tl(III) in solution is slow, the authors have attempted to determine by radiochemical methods whether or not the substances Tl_2Cl_3 and Tl_2Br_3 contain nonequivalent Tl(I) and Tl(III) ions, and whether there is nonadditive light absorption in some aqueous solutions containing Tl(I) and Tl(III). Experimental results showed that within the uncertainties of the experiments there was no exchange in the solid state. For the Tl_2Cl_3 experiment, the calculated ratio of specific activities of Tl(III) and Tl(I) for complete equivalence in the solid was found to be 2.1; for the Tl_2Br_3 experiment, this ratio was 1.0. Absorption spectra were determined for some thallium (I) perchlorate, thallium (III) perchlorate, and mixed solutions in 3.2 and 1.6F perchloric acid. Thallium (III) is more colored than Tl(I) and there was no appreciable nonadditive absorption in the mixed solutions.

426 Separation of Radiosilver (Ag 111). Karl-Erik Zimen. Z. Naturforsch. 4a, 95-6(1949) May (in German).

In connection with two projects in which radiosilver was used as an indicator, a study was made of the chemical separation of this atom from palladium which has been bombarded in a cyclotron. The spearation method is described and data is given concerning the yield and the absorption properties of the radiation from the silver.

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427 Utilization of Radioactive Isotopes in the Study of the Mechanism of a Chemical Reaction: Action of Sulfur Trioxide on Sulfur Bichloride. Roland Muxart, Pascaline Daudel, and Bruno Boscardin. J. chim. phys. 46, 466-8 (1949)(in French).

The isotope S^{35} (87 days) was used for the investigation of the reaction $SO_3 + SCl_2 \rightarrow SO_2 + SOCl_2$. The sulfur bichloride was tagged, and the results showed that the sulfur of SCl_2 is divided between the reaction products $SOCl_2$ and SO_2, the latter obtaining only a small part of that sulfur.

428 Determination of Preferred Orientation in Flat Transmission Samples Using a Geiger Counter X-ray Spectrometer. L. G. Schulz. J. Applied Phys. 20, 1033-6 (1949) Nov.

A method is described for the determination of preferred orientation in flat transmission samples. This method employs a diverging x-ray beam in conjunction with a Geiger counter x-ray spectrometer. It is shown that, for a certain range of sample thickness, the counting rate is independent of the rotation of the samples and, therefore, no correction formula is required.

429 A Direct Method of Determining Preferred Orientation of a Flat Reflection Sample Using a Geiger Counter X-Ray Spectrometer. L. G. Schulz. J. Applied Phys. 20, 1030-1031(1949) Nov.

A new reflection method is described for determining pole figures of flat samples with a Geiger counter x-ray spectrometer. The chief advantage of the method is that the experimental data may be used directly without corrections for changes in geometry during rotation of the sample. A mathematical analysis of the optical elements of the arrangement is given together with the results from a practical application.

430 Atmospheric HDO. H. A. Gebbie, W. R. Harding, C. Hilsum, and V. Roberts. Phys. Rev. 76, 1534(1949) Nov. 15 (Letter to the editor).

The appearance of the ν_2 absorption of HDO in the solar spectrum has been reported by Adel (Astrophys. J. 93, 506(1941)). In the course of measurements made to determine the absolute transmission of the atmosphere for a horizontal path of 2264 yards over sea, the authors found an absorption at 3.67 μ that corresponds to the Q-branch of ν_1 HDO. Absorptions corresponding to the P and R branches were also observed (Barker and Sleator, J. Chem. Phys. 3, 660(1935)). A figure shows a typical transmission curve taken with a lithium fluoride prism. A full account of the work will be published in due course.

431 Pyrolysis of Hexadecafluoroheptane. D. V. Walker and J. D. Gibson. AECU-584(K-502), Sept. 23, 1949. 11p.

The thermal stability and pyrolysis products of hexadecafluoroheptane have been studied at temperatures from 700 to 900°C and space velocities from 0.058 to 0.208 ml/hr/cc. The reactor consisted of an electrically heated 1-in. monel pipe 65 in. long, packed with monel chips; the free space was 88.9%. The hexadecafluoroheptane was decomposed to fluorocarbons of lower molecular weight. Compounds containing one through four carbon atoms both saturated and unsaturated comprised the greatest part of the product. An increase in pyrolysis temperature caused an increase in the amount of low boiling products while an increase in the space velocity caused a decrease in the amount of low boiling compounds. The proportions of the pyrolysis products were extremely sensitive to changes of the surface upon which degradation took place. At a space velocity of 0.100 ml/hr/cc, 18.0% hexadecafluoroheptane was undecomposed at 700°C, and as the temperature was increased to 750°C, the amount undecomposed decreased to 2.0%.

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432 Reactions of Polyfluoro Olefins. II. Reactions with Primary and Secondary Amines. Roy L. Pruett, John T. Barr, Karl E. Rapp, Carl T. Bahner, J. Donald Gibson, Robert H. Lafferty, Jr. AECU-605(K-514), Oct. 28, 1949. 17p.

The reactions of chlorotrifluoroethylene and hexafluorocyclobutene with primary and secondary amines have been investigated. With aliphatic amines these reactions occurred readily and gave a variety of products. In the case of primary aliphatic amines, the products were imino- or imido-type compounds, while secondary amines gave substituted tertiary amines. Primary aromatic amines reacted slowly to yield products of the imino-type structure, but diphenylamine was inert toward both polyfluoro olefins.

433 The Properties of the Citrate Complexes of the Rare-Earth Ions and Their Adsorption on Amberlite Resin. Arthur David Tevabaugh. AECD-2749, 1947, Decl. Nov. 29, 1949. 105p.

The complexes and water-insoluble compounds of lanthanum, neodymium, and samarium with citric acid, the distribution of lanthanum between citrate solutions and Amberlite resins, and the rate of reaction of lanthanum chloride solutions with Amberlite IR-100 have been investigated. Absorption spectra of solutions containing neodymium chloride and citric acid at different pH values indicate the existence of four citrate complexes. An absorption band which appeared at 4278.6 ± 0.5 A is attributed to a H_2cit^- complex of neodymium; a 4286.0 ± 0.5 A band is attributed to a $Hcit^{-2}$ complex; a 4304.0 ± 0.5 A band, to a cit^{-3} complex; and a 4312.0 ± 0.5 A band, to a basic citrate complex. Spectrophotometric measurements on solutions containing neodymium chloride and citric acid at different pH values show the effect of pH on the 576-mμ absorption band of a neodymium chloride solution. In solutions containing citric acid, this band was shifted to longer wavelengths, and the shift was most pronounced in solutions above a pH of 7. Evidence that a hydroxyl group may enter a citrate complex of lanthanum, of neodymium, and of samarium was obtained by titrating trisodium citrate solutions of the rare earths with sodium hydroxide. Other evidence for the citrate complexes was obtained by measuring the distribution of lanthanum between Amberlite resins and citric acid solutions at various pH values. The resins used were Amberlite IR-100 and Amberlite IR-4; radioactive

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lanthanum was employed as a means of analysis. In order to explain the experimental data, the existence of a H_2cit^-, a $Hcit^{-2}$, and a cit^{-3} complex of lanthanum has been assumed. From these data it was calculated that a ratio of one lanthanum to three H_2cit^- existed in one complex; the instability constant was computed to be 6×10^{-7}. The addition of trisodium citrate to an almost neutral solution of either lanthanum chloride, neodymium chloride, or samarium chloride resulted in the formation of a precipitate and in a decrease in the pH of the solution. After the addition of sufficient trisodium citrate to give a one to one molecular ratio between the rare-earth chloride and the trisodium citrate, an abrupt increase in the pH of the solution occurred; and the precipitate gradually dissolved as more trisodium citrate was added. These experiments indicated the existence of several different precipitates between each rare earth studied and citric acid solutions. No additional information concerning the nature of these precipitates has been obtained from measurements of the refractive index of their filtrates. The analysis of a lanthanum citrate precipitate which had been dissolved in ammonium hydroxide and re-precipitated with hydrochloric acid, washed with water, and dried at 115°C corresponds to $La(C_6H_5O_7).2H_2O$. Amberlite IR-100 in the acid cycle was titrated with sodium hydroxide and with ammonium hydroxide. The resin acted as a moderately strong acid, and a break in each titration curve corresponded to 8.58 milliequivalents of hydrogen ion per five grams of air-dried resin. The rate of reaction of a solution of lanthanum chloride with Amberlite IR-100 was found to be dependent upon the pH of the solution and upon the degree of agitation. The concentrations, corrected and uncorrected for ionic strength, of the three citrate ions in a 5% citric acid solution at various pH values have been calculated. Procedures are also suggested for the further investigation of the problem. 85 references.

434 A Complex Praseodymium Fluoride Readily Soluble in Dilute Acids. Theodore P. Perros and Charles R. Naeser. J. Am. Chem. Soc. 71, 3847-8(1949) Nov. (Note).

In the course of investigations concerning praseodymium trifluoride a complex potassium-praseodymium-fluoride compound, possibly new, which was easily soluble in dilute acids, was prepared. The method of preparation is given in detail.

435 Luminescence and Conduction in Solid Solutions of Cerium Sulfide in Strontium Sulfide. Ephraim Banks and Roland Ward. Electrochem. Soc. J. 96, 297-303 (1949) Nov.

Solid solutions of Ce_2S_3 in SrS were prepared by fluxing with LiF. X-ray precision lattice constant measurements show a solid solubility of 1 at. % for nitrogen-fired samples and 10 at. % for H_2S-fired samples. This difference in solubility is connected with the formation of Ce_2O_2S by reaction with traces of oxygen or moisture in the nitrogen. The existence of such a high solubility limit is explained on the basis of the formation of vacancies in the cation lattice (Schottky defects). Measurement of ionic conductivity confirms this.

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From the x-ray and conductivity data, it is concluded that Ce enters the SrS lattice in the trivalent state and in substitutional positions. The luminescent properties of both series of solid solutions show a shift with increasing cerium concentration. The emission peak of N_2-fired series shifted from 4900 A (in a sample with 0.5 at. % Ce) to 5100 A (in samples with 2% Ce or more). The emission peak of the H_2S-fired samples shifts from 5050 A (at 1% Ce) to 5700 A (at 10% Ce). In this series, all samples with 3% Ce or more are only fluorescent, while those with lower Ce content are phosphorescent. These shifts are explained on the basis of a lowering of the bottom of the conduction band with respect to the emitting levels, causing the shift toward longer emission wavelengths, and with respect to the shallow phosphorescent traps, causing the transition from phosphorescence to fluorescence.

436 New Method of Fractionation of Rare Earths Containing Actinium. Marguerite Perey. J. chim. phys. 46, 485-93(1949)(in French).

When ammonia is added to an acetic-acid solution of lanthanum containing actinium, one part of lanthanum and the greater part of actinium remain in the solution; this solubility increases with the increasing quantity of ammonium acetate present. Upon these solubility differences a rapid method of fractionation of actiniferous rare earths is based, a separation of that kind being important in many studies on actinium. The method can also be applied to the fractionation of rare earths. The author obtained solubility curves of rare earths under various conditions, and found that, with the exception of the influence of the presence of thorium, the details of the fractionation are in agreement with the data obtained from the solubility curves. In the method proposed, advantage should be taken of the break of continuity in the sequence of solubilities of rare earths between neodymium and the heavier elements; this should permit good fractionations. The influence of the presence of thorium was pointed out.

437 Superconductivity of Lanthanum, Cerium, Praseodymium, and Neodymium. W. T. Ziegler. Georgia Institute of Technology Technical Report No. 1 (Project No. 116-18), Jan. 1949. 40p. (NP-1157) (See also NSA 1-855).

The results of some magnetic experiments which were carried out to test for the possible occurrence of superconductivity in lanthanum, cerium, praseodymium, and neodymium are outlined. Samples of lanthanum metal from two different sources were investigated and found to be superconducting at 4.85 ± 0.15°K and 4.45 ± 0.10°K, respectively. No magnetic transition was found in specimens of cerium, praseodymium, and neodymium down to 2°K, the lowest temperature reached in these experiments. Power x-ray diffraction studies were made of the samples in the "as received" state. These revealed that both lanthanum samples had a predominantly hexagonal close-packed structure, while the cerium had a predominantly face-centered cubic structure. The results for praseodymium and neodymium were inconclusive. 20 references.

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438 The Theory and Kinetics of Specific Oxidation. III. The Cerate-2,3-Butanediol Reaction in Nitric Acid Solution. Frederick R. Duke and Arlington A. Forist. J. Am. Chem. Soc. 71, 2790-2(1949) Aug.

The oxidation of 2,3-butanediol by cerate is shown to proceed through the disproportionation of a mono-glycolated coordination intermediate involving the oxidizing and reducing agents. Evidence indicates the formation of poly-glycolated coordination intermediates at high 2,3-butanediol concentrations. Tetravalent cerium in nitric acid solution is shown to be coordinated with nitrate ions, hydroxyl ions, and water molecules. In addition this complex is shown to vary with the nitrate ion and hydrogen ion concentration of the solution.

439 Variation in Density and Colour of Cerium Oxide. M. G. Harwood. Nature 164, 787(1949) Nov. 5 (letter to the editor).

R. C. Vickery has stated (Nature 160, 830(1947)) that evidence for more than one crystal structure has been obtained when preparing cerium oxide by igniting various salts of cerium. He classified some preparations he had made into four groups on the basis of density measurements and color estimations. In order to check the structures, six of the preparations on which density and color determinations were made were supplied by Vickery and subjected to x-ray diffraction examination. No evidence for a polymorphic form of cerium oxide was obtained. The observed differences in density and color may be attributed to imperfections in the crystal structure and to the presence of entrapped air.

440 Higher Oxides of the Actinide Elements. The Preparation of Np_3O_8. J. J. Katz and D. M. Gruen. J. Am. Chem. Soc. 71, 2106-2112(1949) June (See also MDDC-1737).

An effort was made to prepare higher neptunium oxides (with an oxygen-metal ratio greater than two) in order to compare their properties with analogous compounds of other actinide elements: in this case uranium oxides were used. Nitrogen dioxide oxidation of U_3O_8 above 250° resulted in a brick-red anhydrous UO_3 with a crystal structure distinct from other known phases of UO_3. Nitrogen dioxide oxidation of UO_2 resulted in products varying in composition from $UO_{2.2}$ to $UO_{2.9}$, depending on the temperature. Treatment of Np(IV, V, VI) hydroxide precipitates (dried at 70°) with nitrogen dioxide at 300-450° yielded Np_3O_8, isomorphous with U_3O_8. Direct analysis of the product led to the formula $NpO_{2.64 \pm 0.03}$. Thermal decomposition curves of UO_3 and Np_3O_8 were compared. The former showed a region of stability corresponding to the formula $UO_{2.91}$. The curve for Np_3O_8 showed no plateau but indicated a marked similarity in the thermal stabilities of UO_3 and Np_3O_8. Attempts at the preparation of NpO_3 and higher oxides of plutonium, americium, and protactinium were unsuccessful.

441 The Preparation of Uranyl Carbonate and Measurement of Its Solubility. P. D. Miller, H. A. Pray, and H. P. Munger. AECD-2740, Aug. 1, 1949, Decl. Nov. 22, 1949. 15p. For publication in NNES.

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A method for the preparation of normal uranyl carbonate has been developed. Heretofore, this compound has been known only as a rare, naturally occurring material. The first preparations were made by adding a quantity of sodium diuranate as a paste to a carbonic acid solution previously heated to 60°C. When it appeared evident that the reaction at normal pressures was not producing the desired product, the operation was conducted in an autoclave. Investigations were made using sodium diuranate, $Na_2U_2O_7$, ammonium diuranate, $(NH_4)_2U_2O_7$, uranium trioxide, UO_3, and uranium hydroxide, $UO_2(OH)_2$, as starting materials. The best starting material proved to be UO_3, since it furnished a product higher in uranium and CO_2 than did the other materials tested. The state of subdivision of the UO_3 and the continuity of suspension appear to be important. Uranyl carbonate is a cream-colored crystalline salt having a density of about 5.7. Its x-ray diffraction pattern consisted of sharply defined lines characteristic of crystalline materials. The solubility of uranyl carbonate in water at 30°C is 0.028 g/1000 g, and at 60°C is 0.083 g/1000 g. These values are very considerably lower than are those for the tricarbonate. Uranyl carbonate reacts with sodium carbonate in solution with the formation of complex compounds which have not been identified, but which appear to include species both lower and higher in carbonate. Equilibrium values are necessary to define these reactions.

442 Hydrolytic Behavior of Metal Ions. I. The Acid Constants of Uranium (IV) and Plutonium (IV). Kurt A. Kraus and Frederick Nelson. AECD-2742, Nov. 7, 1949, Decl. Nov. 23, 1949. 31p.

Through pH measurements of UCl_4 solutions, U^{+4} was established to be the species of uranium (IV) in acidic solutions. The acid constant of U^{+4} was determined as a function of ionic strength for chloride and perchlorate solutions through a spectrophotometric method. The molarity constants could be fitted approximately to a Debye-Huckel limiting law and the activity constant $K_a = 0.21 \pm 0.02$ was estimated for the equilibrium $U^{+4} + 2H_2O \rightleftharpoons UOH^{+3} + H_3O^+$. The stability constant for the reaction $U^{+4} + Cl^- \rightleftharpoons UCl^{+3}$ was estimated to be K_c = ca. 0.63 ($\mu = 0.5$) and $K_c^1 = 7.0$ ($\mu = 0$). The acid constant of Pu^{+4}($K_m = 0.025$, $\mu = 0.5$) was found to be almost identical with, though slightly smaller than that of U^{+4} ($K_m = 0.032$, $\mu = 0.5$). The spectral data, the quantitative hydrolytic data and the observation that the chloride complexes of uranium (IV) and plutonium (IV) are weak, are confirmatory evidence of the hypothesis that these elements are members of a "rare-earth-like" series.

443 Physical Constants of Uranium Tetrachloride. H. S. Young and H. F. Grady (Rev. by C. D. Susano). AECD-2745, Apr. 1, 1947 (Rev. Oct. 3, 1949), Decl. Nov. 22, 1949. 13p. For publication in NNES.

Exceedingly pure UCl_4 was prepared for use in determining the physical constants of the compound. Preparation of the UCl_4 was in a glass apparatus; and it was purified by sublimation and fractional condensation of the vapors, also in a glass apparatus. Measurements were made of the melting point and the boiling point of UCl_4 at pressures ranging from 746 mm of mercury to the triple point pressure, 19.5 mm.

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The average value, 590°C, was also taken as that of the normal melting point. Extrapolation of the boiling point curve gives 792°C as the normal boiling point. Calculations have been made of the vapor pressure equation of the liquid, the heat of vaporization (33×10^3 cal/mole), molar boiling point elevation (26°C), the vapor pressure equation of the solid, and the critical temperature (estimated value, 1325°C).

444 Optical Properties of Three Uranium Phosphates. W. W. Harris and Roberta H. Scott. AECD-2746, Sept. 30, 1949, Decl. Nov. 22, 1949. 13p. Proposed for publication in J. Am. Chem. Soc.

By use of a polarizing microscope, data on the crystal system, crystal habit, and principal refractive indexes have been determined for uranyl hydrogen phosphate tetrahydrate ($UO_2HPO_4 \cdot 4H_2O$), uranyl ammonium phosphate tryhydrate ($UO_2NH_4PO_4 \cdot 3H_2O$), and uranyl phosphate tetrahydrate ($(UO_2)_3(PO_4)_2 \cdot 4H_2O$). A qualitative method for identifying and differentiating these compounds in precipitates by means of the refractive indexes is described. 15 references.

445 Fluorescence and Phosphorescence. Peter Pringsheim. New York, Interscience Publishers Inc., 1949. 794p.

Following an introduction in which the general theory and experimental technique used in the study of fluorescence and phosphorescence are discussed, the material is divided into two sections, i.e., (1) fluorescence of gases and vapors, and (2) fluorescence and phosphorescence of condensed systems. Included is a 36-page discussion of the luminescence of the rare-earth metals and uranyl salts. The natural minerals and crystals which are discolored by irradiation are also discussed.

446 Microstructure of Uranium. H. P. Roth. Metal Progress 56, 662-3(1949) Nov.

Six micrographs are shown along with a few brief remarks. The notation on the various uranium micrographs are as follows: as rolled at 500°C (19% reduction); extruded (2:1 reduction ratio), annealed at 300°C; extruded (8:1 reduction ratio), annealed at 300°C; extruded (2:1 reduction ratio), annealed at 700°C; cold rolled 2%, annealed 500°C; rolled 10% at 500°C, annealed at 600°C.

447 New Structural Types with Densest Packing of Constituent Atoms. N. V. Belov. Doklady Akad. Nauk S.S.S.R. 65, 677-9(1949)(in Russian).

The recently published determinations of the crystalline structure of heavy-element compounds, in particular those containing uranium and the trans-uranium elements (Zachariasen, Acta Cryst. 1, 265(1948); Aurivilius, Arkiv Kemi Mineral. Geol. 26 B, No. 2, (1948)), fit very well into the systematics proposed by the author in his book "Structure of Ionic Crystals and Metallic Phases," Moscow-Leningrad, 1947 (in Russian). The cases discussed here are those of α-UF_5, α-UO_3, UO_2F_2, $CaUO_4$, UCl_6, and Cs_2PuCl_6. The leading idea of the systematics is the densest possible packing of large ions, principally anions.

ENGINEERING

448 Experimental Studies of the Existence of Polarized Turbulence in Flat Rectangular Channels. E. M. Sparrow. AECU-635(ORNL-471), Sept. 8, 1949. 12p.

It was found experimentally that for rectangular channels of width/depth ratios 8, 12, and 24 the same type of flow existed in the vertical and horizontal planes. Mixing lengths were observed to be the same in the two flow planes. Thus the existence of polarized turbulence was not substantiated. The investigation was carried out by observing the motion of a stream of black ink in a water-filled plexiglass channel. Observations were made for Reynolds Numbers, based on the hydraulic diameter, varying from 2000 to 5000.

449 A New Type of Diffusion Pump. E. L. Harrington. Rev. Sci. Instruments 20, 761-2(1949) Nov.

The two-stage mercury diffusion pump of the Kerth type has several disadvantages: it provides no seal between the high and low vacuum sections, it offers no indication of the rate at which gases are being evacuated at any moment and it is very much dependent on the action of the fore-pump. These difficulties are overcome by means of several special features which have been added to the standard diffusion pump. These features may be incorporated into the pump when it is built, or they may be added to a standard mercury diffusion pump. Two possible modes of construction are indicated in schematic drawings.

450 Pumping Speed of Diffusion Pumps below Limiting Pressure. Clifford E. Berry. Rev. Sci. Instruments 20, 835-6(1949) Nov. (Laboratory and shop note).

In a recent paper G. W. Sears (Rev. Sci. Instruments 20, 458(1949)) postulates that the true pumping speed of a diffusion pump should be a constant for all values of pressure below a critical value, and that the commonly used curves of pumping speed as a function of pressure are misleading at low pressures. According to Sears, the apparent pumping speed drops off at low pressures because the evolution of gas from the pump and the rest of the system eventually produces all of the measured pressure regardless of the amount of gas admitted to the system for measuring the pumping speed. For a true pumping speed measurement, the test gas should be one which is not normally evolved from the system, and a mass spectrometer or the equivalent should be used to measure the partial pressure of the test gas. Such an experiment was carried out using helium as the test gas, under conditions described in detail. The results indicate that the pumping speed is independent of pressure, and confirm Sears' conclusions.

451 High Vacuum Shaft Seals, Flanged Joints, and the Gassing and Permeability of Rubber-like Materials. R. H. V. M. Dawton. Atomic Energy Research Establishment Report AERE-G/R-393, Sept. 1949. 57p.

The results of some high vacuum measurements are summarized as follows:

High vacuum shaft seals. Various designs are given. Experiments show that there is little to choose between them from their vacuum performance, although the washer in

which a tension spring is embedded is perhaps to be preferred; and certainly at 120°C these spring-loaded washers give a far superior performance. In all cases a lubricant is necessary and for this a thin high vacuum oil is better than a high vacuum grease. With reciprocating shafts, some 85% of the leak occurs on the inward stroke, being about 0.01 liter-microns/cm of stroke, for a 3/8 in. diameter shaft. When the shaft is stationary, the leakage, again for a 3/8 in. diameter shaft, is about 0.001 liter-microns/sec and is but little more with slowly rotating shafts (1 rev/sec). The above leakages do not consist entirely of air from the atmosphere, as about 90% of the leakage is condensable by liquid air. A smooth surface on the shaft is always of primary importance.

Gassing rates and permeability of rubber, neoprene, and butyl rubber. The experiments give measurements of the gassing from rubber-like materials when totally enclosed in a vacuum system, and also measurements of the transmission of gases through the materials when separating a vacuum from the atmosphere. For continuously pumped high vacuum systems, the gassing effect is generally not serious after the first few hours of pumping. Different materials vary considerably in their outgassing characteristics, and all the synthetic rubbers tested gassed considerably more than did rubber. The permeability effect can be more serious, and is such that it forbids the use of rubber bellows and diaphragms in most high vacuum systems. The permeability, unlike the gassing effect, is considerably less with the synthetic rubbers tested than with rubber. Thus the passage of air through a centimeter cube of rubber having a pressure difference of an atmosphere between opposite faces is about 0.05×10^{-3} liter-microns/sec; for neoprene the value is about 1/3 to 1/4 of this. Coating the diaphragms with vacuum greases or vacuum paints makes almost no difference to this leakage of gases. The time required for gases to pass through a 1/16 in. thick diaphragm varies from a few minutes to about one hour, depending on the gas.

High vacuum flanged joints. Different gasket joints are tested. Data are given of their effect on a vacuum system during the first 20 hr of pumping when the joint gassing is liable to be confused with a leak. Data are also given on the flange clamping pressure necessary for a tight joint. Gaskets of circular section appear rather better from the vacuum performance than do the square sectioned gaskets, but mechanically they tend to be unsatisfactory since with high clamping pressures they can split round their outer edge. Because of this, square sectioned gaskets properly clamped appear best for metal flanges; but for glass apparatus where clamping pressures are not great, round gaskets are often preferred. The results of tests on silastic gaskets operating at 200°C and 300°C are also given.

Experimental apparatus and procedure. In this section the procedure used for the experiments mentioned above is given, and some of the difficulties are discussed. Some results are given of a test on an apparatus designed to measure simultaneously the total gassing and the noncondensable gassing from a vacuum system.

452 McLeod-type Alloy-filled Vacuum Gauge. Janusz Groszkowski. Nature 164, 886-7(1949) Nov. 19 (Letter to the editor).

The mercury-filled McLeod gauge introduces a small amount of mercury vapor into the vacuum system, and this is a very serious handicap at very low pressures. The mercury pressure at normal temperatures is about one micron. Liquid air traps may be used but they are inconvenient, and nonvolatile organic fluids have the disadvantage that many gases are soluble in them. To avoid these difficulties, an easily fusible alloy may be used in the gauge. An alloy of lead, tin, bismuth, and cadmium is suggested, and it is noted that the vapor pressure of this alloy at 373° K would be negligible. An experimental gauge of this type was constructed, and the details of construction and operation are described.

MINERALOGY, METALLURGY and CERAMICS

453 Production and Properties of Ceramic Bodies of Alkaline Earth and Other Refractory Oxides. W. H. Keller, David Peterson, and Louis Handlin. AECD-2743, Aug. 1945, Decl. Nov. 22, 1949. 23p.

Liners for reaction chambers, crucibles for melting metals, casting molds, insulation shields, thermocouple shields, and other heat resistant bodies have been used at Iowa State College. It was necessary that these bodies be made of inert refractory materials of high purity. The selection and preparation of the materials and the fabrication and firing of the bodies are described. High calcium lime was found to have the necessary chemical and thermal properties for many of the above uses. The difficulties due to its hygroscopic nature were mitigated to some extent by proper processing and care of the products. Various modes of processing are described and their effects compared. Lime sintered at 1750°C and ground to −200 mesh was found to form satisfactory bodies. Methods of formation of ware of various materials are described. Bodies were formed in the annular space between a mandrel and a form or mold concentrically arranged. The refractory was compacted either by jolting on a solid surface by hand, by jolting mechanically as by a pneumatically operated jolting table, or by pressing by a punch and sleeve in a tool-steel die. The porosity, density, and other properties of bodies prepared by these methods are compared. Die-pressing produced the most uniform and dense bodies, but dies are too expensive for producing experimental models in small numbers. The effects of various factors on the density of the ware are described. Of the available forms of high calcium lime the sintered form produced the most dense ware. Fused lime failed to cohere as well as sintered lime. It was found that a minimum temperature of 1850°C was required to produce good lime ware; and that the time of firing varied with the maximum temperature, a few minutes at 2100°C being sufficient and longer times being required for lower temperatures, up to one hour at 1850°C. Very pure lime failed to cohere well at the above temperatures, while lime with some SiO_2, Fe_2O_3, MgO, or other contaminant formed strong, dense bodies under the same conditions. Hence, the addition of different fluxing agents in varying proportions was investigated, with the result that BeO, Al_2O_3, and TiO_2, in the range of 1-5%, were found most effective. For some purposes lime ware was not suitable hence other refractories were also used in the production of ceramic bodies. Magnesia formed more dense, uniform bodies than did lime and could be used for many purposes. Magnesia ware was formed in the same ways as was lime

ware. Since fused magnesia was used, however, it did not cohere as well on simple jolting and sintering; hence a binder was frequently used. On large ware (4 in. or more in diameter), the magnesia was wetted after jolting and dried before firing. The resulting ware was uniform and strong. Some metals attack both lime and magnesia ware at the melting temperatures of those metals. Beryllia, due to the lower volatility of beryllium, is less attacked under such circumstances and is usable in many cases where the others are not. Beryllia ware was fabricated by all of the above procedures and also by die pressing with paraffin as a binder. Beryllia ware was particularly strong, resistant to thermal shock, and chemically inert. Lime and magnesia both served as effective fluxes in improving the density of beryllia. 11 references.

454 High Melting Silicides. Leo Brewer, Alan W. Searcy, David H. Templeton, and Carol H. Dauben. AECU-607 (UCRL-434), Aug. 28, 1949. 17p.

In this paper a preliminary survey is made of the refractory properties of silicides of groups III through VII; and the tantalum-silicon, molybdenum-silicon, and tungsten-silicon systems have been investigated for solid phases stable above 1900°K. Three new tantalum silicide phases, two new molybdenum silicide phases, and one new tungsten silicide phase, are reported besides the MSi_2 phases previously known. The crystal structure of Mo_5Si is described. Lower limits for eutectic temperatures are given for the tantalum-silicon, molybdenum-silicon, and tungsten-silicon systems; and the relative stabilities of the group III through VII metallic silicides are discussed. 14 references.

455 Mullite and Zircon Furnace Tubes for High Temperature and High Vacuum Systems; New Method for Measuring Pressure. Earl. A. Gulbransen and Kenneth F. Andrew. Ind. Eng. Chem. 41, 2762-7(1949) Dec.

This paper describes the design, construction, and testing of refractory porcelain furnace units which are of double-walled construction and which can be sealed direct to a Pyrex glass vacuum system. Pressures of 10^{-8} mm of mercury or better can be obtained with these units at 1175°C. A new method for measuring the performance of a furnace tube is suggested which utilizes the measurement of the rate of reaction of zirconium with gases present in the furnace tube.

456 Phase Diagrams for Ceramists: Supplement No. 1. Howard F. McMurdie and F. P. Hall. J. Am. Ceram. Soc. 32, Part II, 154-64(1949) Dec. 1.

The authors present binary and ternary diagrams of various oxide and fluoride systems. The systems considered are as follows: metal oxide systems containing two, three, and four oxides, i.e., $BeO-SiO_2$, $LiO-Al_2O_3-SiO_2$, and $NaO-CaO-Al_2O_3-SiO_2$; systems containing nonmetal oxides, halides, etc., i.e., $LiF-BeF_2$, $CaF_2-CaO-SiO_2$. Also included are liquidus curves for $MgO-Al_2O_3-ZrO_2$ and temperature deformation diagrams for $Al_2O_3-SiO_2-ZrO_2$.

457 Phosphate Glass: $PbO-WO_3-P_2O_5$ System. Joseph J. Rothermel, Kuan-Han Sun, and Alexander Silverman. J. Am. Ceram. Soc. 32, 153-62(1949) May 1.

The glass-formation region has been determined for the $PbO-WO_3-P_2O_5$ system and certain physical properties of representative glasses have been measured. Glasses of the system show an unusually high x-ray and γ-ray absorption and are not readily discolored when exposed to x-rays. Equations have been developed from which specific volumes and lead equivalents may be calculated from composition. Because of their high index of refraction and relatively low dispersion these glasses are also useful for optical purposes.

458 The Vapor-Phase Deposition of Refractory Materials. I. General Conditions and Apparatus. I. E. Campbell, C. F. Powell, D. H. Nowicki, and B. W. Gonser. J. Electrochem. Soc. 96, 318-33(1949) Nov.

General conditions and apparatus for applying coatings of the refractory metals, carbides, nitrides, borides, silicides, and oxides by vapor-phase deposition are described. This process consists essentially of reducing, reacting, or decomposing a volatile compound of the coating material at a heated surface. Thick, adherent deposits have been obtained on a variety of bases, both metallic and nonmetallic. A few of the properties of the deposits are described, along with their limitations and potential uses as protective coatings for high-temperature service.

459 The Age of Uraninite and Monazite from the Post-Delhi Pegmatites of Rajputana. Arthur Holmes, A. A. Smales, W. T. Leland, and A. O. Nier. Geol. Mag. 86, 288-302(1949) Sept.-Oct.

Uraninite and monazite collected from pegmatites occurring, respectively, at Bisundni and Soniana (Rajputana) have been analyzed for U, Th, and Pb by Smales, and the isotopic constitution of the lead separated from each mineral has been determined by Leland and Nier. The three ages calculated from the uraninite ratios AcD/RaG, RaG/U and AcD/U are 740, 733, and 733 million years. The monazite is considerably altered but the corresponding ratios indicate that its age lies between 700 and 865 million years, which is consistent with the more reliable estimate determined from the uraninite. It is shown from tectonic evidence that the Delhi orogenic belt is younger than the Satpura belt (previously dated at about 900 million years) and that both are younger than the Aravalli and Dharwar belts. 31 references. 5 tables.

460 Geology of the Deep-Sea Floor. J. D. H. Wiseman. Nature 164, 682-4(1949) Oct. 22.

The six papers given before the geological section on problems concerning the deep-sea floor at a recent meeting of the British Association at Newcastle upon Tyne are discussed and some relevant information and comments added. The papers discussed included "The Chronology of the Ocean Floor" by H. Pettersson (Nature 164, 468(1949)) and one by the author on manganese nodules found on the surface of the deep-sea floor of the Arabian basin. These nodules are associated with red clay and are largely composed of manganese,

iron, and water and contain, in addition, unusual amounts of nickel, copper, cobalt, barium, and radium. Definite confirmation about the fragmentation of spherical nodules and the deposition at a later date of a secondary manganese layer is given by the distribution of radium in tetrahedral nodules. The radium content of the secondary peripheral layer is practically constant (11×10^{-12} g/g), while immediately below this layer the content is much lower (0.9×10^{-12} g/g), and toward the center no radium could be detected. It is clear from these determinations that the original nodule was spherical with increasing radium content toward the periphery, and that it afterwards broke into tetrahedral masses, around which a secondary layer of manganese material was deposited. The Pettersson paper dealt with the methods used for correlation in deep-sea cores; first the radioactive method, second the mineralogical method, third the pollen analysis method, and fourth the biological method. The significance of the high content of radium in sea-water, which has been noted in his article in Nature, is discussed.

461 A Note on the Geochemistry of Thallium. Kalervo Rankama. J. Geol. 57, 608-13(1949).
The manner of occurrence of Tl in the upper lithosphere is discussed. The value 0.6 g/ton is tentatively adopted for the abundance of Tl in igneous rocks. The presence of notable variations in the Rb/Tl ratio in igneous rocks is established. The geochemical coherence of the pair Rb-Tl is discussed and compared with the coherence in the pairs Ga-Al, Cb-Ta, and Zr-Hf, and in the group of lanthanum and the lanthanides. It is concluded that Zr and Hf probably form a more coherent pair than do Rb and Tl.

462 On a Radioactive Inclusion, with a High Uranium and Thorium Content, Found in a Granite. René Coppens. Compt. rend. 229, 617-9(1949) Sept. 26 (in French).
Continuing his study of radioactive inclusions in rocks, by inspecting the tracks produced by them in a photographic emulsion, the author describes an α-radioactive grain in a granite from the Angers region in France. The size of the inclusion was 45×10^{-4} mm^2 (projection). The ranges observed were of two kinds: over 7 cm and 5.8-7 cm. The number of α rays emitted by 1 cm^2 of the inclusion in 1 sec was 185. These data were not sufficient for an accurate determination of the chemical composition. However, an approximate estimate could be made by using the formula given by I. Curie (J. physique (1946) Nov.) $(8.4\ C_U + 2.5\ C_{Th})\ k' = N$, where C_U and C_{Th} are, respectively, the uranium and thorium contents, k' is a constant depending on the emulsion, and N is the number of α rays/cm^2/sec. It was found that the inclusion examined contained about 65% uranium and a few per cent thorium.

463 The Radioactivity of Several Wells in Libya and Syria. Francois Dupré la Tour. Compt. rend. 229, 712-3(1949) Oct. 10 (in French).
The author presents the results of a series of measurements made on the water of the principal wells of Libya and Syria. Standard procedure was used for the measurements, but, because of the careful construction of the apparatus, activities of the order of 5×10^{-12} c/l could be detected. The water was analyzed for radium and radon content. Only one well contained an appreciable percentage of radium, but the radon content of all the wells is tabulated.

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464 Cathodic Vacuum Etching of Metals. Don M. McCutcheon and William Pahl. Metal Progress 56, 674-9(1949) Nov.
The theory of cathodic etching of metal is briefly discussed, and the equipment necessary for cathodic vacuum etching is described. Several photomicrographs of samples are shown prepared by acid etch and cathodic etch. The structures revealed by the different etching procedures are briefly explained. The cathodic vacuum etching method was found superior in revealing flow lines and for use in highly alloyed metals which are difficult to etch chemically.

465 Creep of Titanium at Room Temperature. Heinrich Adenstedt. Metal Progress 56, 658-60 (1949) Nov.
A table is shown listing the composition, condition, and properties of the commercially pure titanium. Four figures are included illustrating the following: creep of annealed titanium sheet at room temperature; creep of cold rolled titanium strip at room temperature; variation in the creep rate of titanium at room temperature; comparison of minimum creep rates of titanium and other structural metals. The cold rolled titanium showed considerably higher yield strength and a reduced tendency for creep as compared to the annealed metal.

466 Metallography of Beryllium. A. R. Kaufmann, P. Gordon, and D. W. Lillie. Metal Progress 56, 664-5 (1949) Nov.
Fifteen micrographs of beryllium and a few of its alloys are shown and a brief description is given on the metallographic technique employed.

467 Metallography of Zirconium and Zirconium Alloys. A. H. Roberson. Metal Progress 56, 667-9(1949) Nov.
The author discusses the metallographic technique employed in preparing zirconium and zirconium alloys. The etchants which were found to be most satisfactory are listed, and electrolytic polishing and etching are briefly mentioned. Twelve photomicrographs are included.

468 Report on Lithium. D. S. Jesseman. NEPA-1193, Oct. 20, 1949. 54p.
This compilation of available information on lithium comprises the following sections: property data, fabrication data, preparation methods, analysis, equilibrium studies with other elements or compounds, structural studies and changes in properties under exposure to radiation, nuclear data, and bibliography (82 references). Phase diagrams for some lithium alloy systems are included.

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469 Solubility of Titanium in Liquid Magnesium. K. T. Aust and L. M. Pidgeon. J. Metals 1, 585-7(1949) Sept.

Titanium was added to molten magnesium in various forms to determine the extent of its solubility in the latter. The magnesium was melted in graphite crucibles under an atmosphere of argon. The whole assembly was enclosed in a silica tube. Metallographic and x-ray investigations revealed the following: (1) The solubility of titanium in liquid magnesium increases from 0.0025% at the freezing point of magnesium to 0.015% at 850°C. (2) The solid solubility of titanium in magnesium could not be detected using x-ray diffraction methods.

470 A Study of the Mechanism of Sintering of Metallic Particles. J. H. Dedrick and A. Gerds. J. Applied Phys. 20, 1042-4(1949) Nov.

An investigation has been carried out on the mechanism of sintering of metallic particles. Single layers of spherical copper particles have been sintered under varying conditions of time and temperature in a dry hydrogen atmosphere. Analysis of the rate of interface contact between the particles has shown metallic sintering to be a diffusion process, in agreement with the theory of Kuczynski. The heat of activation of self-diffusion of copper has been calculated and found to be 55,000 cal/mole. This is in close agreement with Kuczynski and also values obtained by other workers using the radioactive tracer method.

471 Zirconium Widens its Industrial Orbit. Warren B. Blumenthal. Chem. Inds. 65, 728-30(1949) Nov.

Brief consideration is given to newer uses of Zr, such as in the textile, leather, and pigments fields. Its principal consumption, however, is in refractories, ceramics, and metallic alloys.

472 Can Uranium Mining Pay? A. W. Knoerr. Eng. Mining J. 150, 65-71(1949) Dec.

The author discusses the uranium country in Colorado and its geology along with the various allowances and payments made for uranium and vanadium content. Three points are listed for reducing uranium mining costs. They are, group operations, pre-concentration of ores, and reducing long haulage by short-circuiting from the mines on the plateau to canyon roads with aerial cable equipment.

473 Determination of Uranium in Ores by Field Analysis. F. E. Senftle and C. McMahon. Can. Mining Met. Bull. 42, 618-21(1949) Nov.

Two methods are presented for determining the uranium content of ores in the field. They are, the field estimate method and the field assay method. A portable Geiger counter with a rate meter is generally used for this type of work. In the estimate method, the deflection for each of the several sides of the specimen are recorded. The net readings are averaged and the sample is weighed. The approximate percentage U_3O_8 equivalent (C_x) is obtained by comparison with the standard.

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$$(C_x) = \frac{W_S\, C_S\, N_x}{W_x\, N_S}$$

where W, C and N are the weight, per cent U_3O_8 equivalent, and net deflection, respectively. Subscripts s and x refer to the standard and the unknown sample. For best results a hammer is used to chip down the sample to the approximate size and shape of the standard. In the field assay method, the associated necessary equipment consists of a suitable set of standards, standard ore trays, an iron mortar and pestle, a simple scale, a screen (35 mesh), and a rock sledge hammer. The sample to be analyzed is roughly crushed with a field hammer and then further reduced to 35 mesh or smaller in the mortar. It is then placed in a tray of the same shape and volume as that holding the standard with which it is compared.

474 Titanium Investigations: The Laboratory Development of Mineral-Dressing Methods for Arkansas Rutile. M. M. Fine, H. Kenworthy, R. B. Fisher, and R. G. Knickerbocker. Mining Eng. 1, 447-52(1949) Dec.

The results of an investigation of the ore-dressing characteristics of titanium-bearing ores of the Magnet Cove area of Arkansas are presented. The treatment process included disintegration of the ore by tumbling in a revolving cylinder and subsequent removal of clay by classification. Gangue minerals and some pyrite were removed by gravity concentration. The rest of the pyrite was removed from the coarse sizes by agglomerate tabling and from the fine sizes by flotation. A finished rutile concentrate was then recovered by sizing, classification, tabling, and magnetic separation. This treatment gave a recovery of 46.35% of the titanium in a product containing 92.2% titania, 1.4% iron, 0.63% silica, 0.52% lime, 0.09% sulphur, and 0.29% phosphorus. The investigation has shown that the production of commercial-grade rutile concentrates from the Magnet Cove property is technically feasible.

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475 Abundance of Rare Gases on Earth and in the Universe. Hans E. Suess. J. Geol. 57, 600-7(1949) Nov. (in German).

It is assumed that the cosmic abundance of neon is closely approximated by Unsöld's value. The values for the other gases has been determined in a way previously described by the author. It appears that the ratio of the relative abundances of neon and xenon on the earth differs considerably from it's value in the rest of the universe. This can be understood if we assume that selective diffusion has taken place over a limited period in the earth's evolution when, presumably, the earth's period of rotation was very short. Useful data might be obtained by investigating the isotopic composition of Ne and A from natural sources containing excessive amounts of neon.

476 Degenerate Matter and Astronomy. Pierre Rousseau. Nature, La, No. 3175, 321-6(1949) Nov. (in French).

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The causes and effects of complete ionization in stars is described in nontechnical terms. An estimate is given of the pressure necessary to produce complete degeneracy, and a plot is given (due to Chandrasekhar) of the relations between the mass and radius of a sphere of atomic number 2. This discussion is then applied to the case of white dwarf stars, and the relativistic effects of the high density of these stars is outlined.

477 The Energy of the Stars. R. d'E. Atkinson. Observatory 69, 161-84(1949) Oct.

The development of theories to explain the sources and nature of stellar energy is described and some of the related nuclear physics data are reviewed. 28 references.

478 Some Recent Researches in Solar Physics. F. Hoyle. Cambridge, Cambridge University Press, 1949. 134p.

The following topics are treated: observational data on sunspots, the solar cycle, chromosphere and corona; new theories of the origin and structure of the chromosphere and corona; electromagnetism in the solar atmosphere; solar and terrestrial relationship; emission of radio waves by the sun; the origin of general solar magnetic fields.

479 Electrical Detection of Artificially Produced Mesons. L. W. Alvarez, A. Longacre, V. G. Ogren, and R. E. Thomas. AECU-587(UCRL-466), nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Scintillation counters have been used to detect the electrons from the decay of mesons. The decay of the μ meson has been followed over an intensity range of almost 10^4, and the measured mean life is 2.09 ± 0.03 μsec. The fact that this may be less than the free space lifetime may be explained by the presence of a small component of negative μ's. Almost all of the μ's are positive, as they come from the decay of π's. Although the latter have both signs, negative π's produce stars in matter and so do not give negative μ's unless the process occurs "in flight." Now that the technique has been shown to be reliable, it becomes possible to determine the energy spectrum, the angular distribution, and the total cross sections for the production of positive π mesons as functions of Z and the proton bombarding energy. For such determinations, the μ decay is used as a "tracer," to tell where a π meson has ended its range. Since the combined ranges of the μ and electron are small compared to the π range, no appreciable errors are introduced by the tracer technique.

480 Meson Mass Measurements at the University of California Radiation Laboratory. Walter H. Barkas. AECU-591(UCRL-426), Aug. 23, 1949. 10p.

Three methods for determining meson masses are described: (a) determination of meson mass relative to proton mass by grain counting in nuclear emulsion; (b) determination of meson mass by momentum and range utilizing range-energy relation constants derived from empirical proton range-energy relation; (c) determination of meson mass relative to that of proton by momentum and range ratio method. Each method assumes that the charge of the meson is the same as the charge of the proton. The approximate agreement of the results by different methods provides support for this assumption, because the charge enters the methods in profoundly different ways.

481 Calibration of a Nuclear Physics Plate: Application to the Study of Isolated Tracks Produced by Cosmic Rays at Sea Level. Jean Edmont. J. phys. radium 10, 22-32(1949) Jan. (In French).

The study of charged particles by the method of photographic plates is sometimes difficult, first, because the particle may not stop in the plate and, second, because the track may fade before development. Experiments have been carried out with protons produced in nuclear reactions to study the effects of fading. It has also been possible to establish an empirical relation between linear grain density and residual range. This relation should facilitate the study of tracks which do not stop in the emulsion. The paper includes some considerations on the relation between grain density and energy loss, and concludes with the experimental interpretation of several cosmic ray tracks at sea level.

482 The Meson Intensity at the Surface of the Earth and the Temperature at the Production Level. A. Duperier. Proc. Phys. Soc. (London) 62 A, 684-96(1949) Nov. 1.

Meson intensity has been recorded by using a triple-coincidence arrangement with a lead absorber 25 cm thick between the counters. The comparison of daily mean values with the height of a number of pressure-levels has led us to take into consideration the temperature of the air layer between 200 and 100 mb. The results show that this temperature appears to be a factor closely controlling the meson intensity at the surface of the earth; the intensity increases with increasing temperature at the rate of 0.12%/°C. Other factors in determining the intensity are the mass of air and the height of the 100 mb level over the station. The corresponding coefficients of adsorption and decay prove to be comparable with those obtained from other measurements for mesons of the same momentum. It has also been found that the coexistence of the three effects permits explanation of the variability exhibited by the barometric coefficient when evaluated from short periods of observations. These results may, therefore, be taken as evidence that the bulk of mesons is produced at the height of 100 mb. If the positive effect of temperature is interpreted as the result of processes of decay and interactions with air nuclei of π-mesons at the production level, then the coefficient 0.12%/°C leads to a value of 4.9×10^{-8} sec for the upper limit of the mean life of π-mesons.

483 Multiplicity in the Hard Component of Cosmic Radiation Underground. E. P. George and P. T. Trent. Nature 164, 838-9(1949) Nov. 12. (Letter to the editor)

Evidence for the production of groups of penetrating particles at a depth of 60-m water equivalent of London clay has been

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obtained in experiments made underground with the penetrating-burst apparatus previously described (Nature 161, 248 (1948)). The three-fold coincidence recording method used is described. It is noted that in a period of about 57 hr, 6,806 events were recorded, of which about 3.55% indicated the discharge of two or more adjacent counters and were attributed to knock-on showers accompanying the penetrating particle; a further 0.9 ± 0.15%, however, could not be satisfactorily explained in this manner, as the separations of the counters discharged in the bank of 18 counters in these cases varied from one to eleven intervening undischarged counters, with a frequency-separation distribution showing only a slow decrease of frequency with increasing separation. It is suggested that this can be explained by a process of production of groups of mesons by mesons with a cross section of 5×10^{-29} cm²/nucleon, as the consequence of radiative collision of a meson with a nucleus in the absorber. This value is in agreement with the value obtained by Wilson (Proc. Roy. Soc. (London) 174 A, 73(1940)) for large-angle scattering of mesons at sea-level and also with the result obtained by Evans and George (Nature 164, 20 (1949)) for star production in photographic plates.

484 Note on the Decay of the π-Meson. M. Ruderman and R. Finkelstein. Phys. Rev. 76, 1458-60(1949) Nov. 15.
Assuming the symmetric coupling scheme proposed by Wheeler and Tiomno (Revs. Modern Phys. 21, 153(1949)), and others, the ratio of the decay rate π meson → electron + neutrino to the decay rate of π meson → μ meson + neutrino is computed. The electron-neutrino decay proceeds faster, in disagreement with experiment, unless the π meson is pseudoscalar and the β-decay coupling is pseudovector. Hence if the symmetric coupling scheme is correct and no other direct couplings are introduced, the π meson must be pseudoscalar and β decay must be at least partially pseudovector. If symmetric coupling is not assumed, no conclusion of this kind can be drawn.

485 On the Decay of τ-Mesons. C. B. van Wyk. Proc. Phys. Soc. (London) 62 A, 697-709(1949) Nov. 1.
The production of τ-mesons (mass about 900 electron masses) by cosmic rays in rather thin layers of air in the upper atmosphere seems to indicate that the nucleon τ-meson coupling constant is not very small. The Berkeley experiments show that this is also true for the nucleon-π-meson coupling constant. Consequently, the decay of a charged τ-meson into a photon and a charged π-meson by means of virtual creation and annihilation of nucleons ought to be fairly probable. In this paper this decay process, with the emission of one photon, is studied for the various types of τ- and π-mesons. Unless both mesons have zero spin, the matrix elements and, therefore, the lifetimes, are found to be of the same order of magnitude, and the τ-meson turns out to be too short-lived to be observed photographically.

486 On the Origin of the Solar Component of the Cosmic Radiation. Ludwig Biermann and Erich Bagge. Z. Naturforsch, 4a, 303-15(1949) July (in German).

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Variable magnetic fields in the neighborhood of sunspots are considered to accelerate fast particles, thus giving rise to cosmic radiation. A special model is used for this process for which the equations of motion can be integrated in closed form. It is shown that for complicated groups of sunspots accelerations parallel to the magnetic field occur. If this happens along magnetic field lines far from the sunspots, it is shown energetically possible for accelerated particles to leave the sun. The discussion is primarily limited to the case of variable sunspots in rarified matter whose effect on the propagation of the magnetic fields can be neglected. It is to be expected that the energy spectrum of the solar cosmic radiation does not have a lower limit at 10^9 ev, but that much energy is transmitted in the form of particles of lower energies. A local lowering of particle density is shown to be essential for the production of solar cosmic radiation. Finally, the question is discussed whether the entire cosmic radiation might have its origin in the sun, and in connection with this the influence of the expansion of the universe on the energy spectrum of the cosmic radiation.

487 On the Production of π-Mesons by Nucleon-Nucleon Collisions. Cecile Morette. Phys. Rev. 76, 1432-9 (1949) Nov. 15.
A similar article by the author appeared in Proc. Royal Irish Acad. 51 [A], 217-37(1948) Feb. and was listed in NSA as abstract No. 1-1002.

488 On the Size-Frequency Distribution of Penetrating Showers. W. Heitler and L. Jánossy. Proc. Phys. Soc., (London) 62 A, 669-83(1949) Nov. 1.
The authors have calculated the relative number of showers containing n mesons when a fast primary nucleon hits a compound nucleus on the assumption that in a single nucleon-nucleon collision only one meson is produced (pure plural production). The cross section for meson production is assumed to have the form $\Phi(\epsilon/E)d\epsilon/E$, where E is the energy of the primary and ϵ the energy lost by it, but the absolute value of Φ and its dependence on ϵ/E are left open. The fluctuations of the shower size are duly taken into account. For comparison with experiments it is assumed that about half the number of fast shower particles are fast protons as suggested by the positive excess of penetrating shower particles. The theoretical results depend on two constants, the total cross section and some weighted average over the energy distribution $\Phi(\epsilon/E)$. Choosing these suitably, the results are in good agreement with the relevant data within the experimental statistical errors, and the agreement extends also to the "large showers" with 20 or so thin tracks. The values of the constants thus determined are physically reasonable. It is concluded that the size-frequency distribution of penetrating showers can be fully understood on the basis of pure plural production, but some—small or large—contribution from multiple processes cannot be excluded.

489 Varitrons. S. B. Gurevich. Priroda No. 1, 59-62(1949) (in Russian).
An account is given of the discovery, by Russian physicists, of particles of various masses, "varitrons," in cosmic rays.

Most of the work has been done, since 1942, in the mountain laboratory Alagez (3,250 m) in the Caucasus. Alikhanov et al (Zhur. Eksptl. i Teoret. Fiz. 15, 145(1945)) pointed out that the ratio of the intensities of the soft and the hard components, as determined by particle counting, differs from the same ratio determined from the ionization effect, and concluded that this disagrees with the assumption that the soft component consists solely of electrons, photons, and a small proportion of slow mesons. Using an electric field that removed the electrons and slow mesons, Alikhanian et al (J. Physics U.S.S.R. 10, 294(1946)) proved the presence of heavy particles, positive and negative, in the soft component. Later, the same authors (Doklady Akad. Nauk Armyanskoĭ S.S.R. No. 5, 129 (1946); J. Physics U.S.S.R. 11, 97(1947); Zhur. Eksptl. i Teoret Fiz. 18, 301(1948)), by the same method of magnetic analysis, found in the soft component at least three kinds of particles heavier than the meson; simultaneously, Nikitin (J. Physics U.S.S.R. 11, 196(1947); Zhur. Eksptl. i.Teoret. Fiz. 18, 577(1948)), studying the ionization properties of the particles, found the values (300-500), (700-1,100) and (2000-3500)m_e, where m_e is the mass of the electron. Lattes et al (Nature 160, 543(1947)) observed in photoemulsions several cases of emission of a meson $200m_e$ by a stopped particle whose mass must be $400m_e$. In later publications, Alikhanian et al (Doklady Akad. Nauk S.S.S.R. 58, 1321(1947); 60, 1515 (1948); 61, 35 and 39(1948); Zhur. Eksptl. i Teoret. Fiz. 18, 673(1948)) described the discovery, by using the same mass-spectrometric method, of as many as 16 kinds of varitrons, with masses occupying the range 110-20,000m_e, both positive and negative, and present both in the soft and the hard component of cosmic rays; their half-life period is about 2×10^{-6} sec; there exists a characteristic maximal momentum for every kind of varitron, which points to a generation of these particles from one another. Recently, Powel et al (Nature 161, 551(1948)) reported on the artificial generation of particles $(316 \pm 16)m_e$ by bombarding various nuclei with α rays of 400 mev.

490 An Electrical Recording Dial Gage. R. F. Plott. AECU-612(ANL-4335), Aug. 19, 1949. 7p.

An electrical device for continuous automatic recording of linear displacement has been constructed by adoption of a continuously variable resistance mechanically-coupled to the pointer shaft of a standard dial gauge of 1-in. range. The displacement is translated into potential drop across the resistance and recorded upon a potentiometer recorder. Direct observation of the mechanical displacement can be compared at any time with the recorded displacement. Tests indicate that the readings are reproducible and are linear to within ±0.00026 in.

491 The Characteristics of High-Megohm Resistors in Ion Current Measurements. K. E. Burmaster. AECU-618, nd. 25p.

High value resistors manufactured by the Victoreen Instrument Company, International Resistance Company, S. S. White Dental Manufacturing Company, and Resistance Products Company with 2 experimental resistors have been tested and evaluated for use in electrometer circuits in analytical mass spectrometers. Determinations were made of resistance values, polarization time constants, noise limits, and drift rates. Methods and test equipment used are described. A discussion as to acceptance of resistor types under average operating conditions with certain recommendations is included. An insulating technique for standard type resistors is suggested.

492 An Absolute Noise Thermometer for High Temperatures and High Pressures. J. B. Garrison and A. W. Lawson. Rev. Sci. Instruments 20, 785-94(1949) Nov.

A null device for determining the ratio of two absolute temperatures with an accuracy of 0.1% is described. This device balances the mean-square fluctuations in voltage across the terminals of two resistors arising from thermal agitation at the temperatures to be compared. The ratio of the resistances, when the noise voltages from the two resistors are equal, determines the ratio of their absolute temperatures. The limitation on the ultimate accuracy of the ratio of temperatures so determined is imposed by the relative value of the first and second moments of the voltage fluctuations observed, which in turn depends on the length of time utilized in averaging the fluctuations. With the apparatus described below, an observation time of 2 min is adequate to guarantee the accuracy claimed above for high temperatures, provided certain elementary precautions in constructing the noise thermometer are observed. Numerous tests have been conducted in the neighborhood of 1000°K which substantiate these claims. Extrapolation of the performance obtained at such temperatures indicates that material improvements in the accuracy of the absolute temperature scale above 2000°K may be obtained. The calibration of the thermometer is independent of the chemical composition and past physical history of the material from which it is constructed, in addition to being independent of the absolute pressure.

493 A microwave Secondary Electron Multiplier. M. H. Greenblatt. Rev. Sci. Instruments 20, 646-50(1949) Sept.

The construction and operation of a dynamic electron multiplier, of the type sometimes called a multipactor, is described. Briefly, the multipactor consists of two parallel secondary emissive plates having an alternating voltage across them. The magnitude of the voltage is adjusted so that the transit time across the gap for electrons starting with zero velocity from one of the plates when the field is passing through zero shall be just one-half the period of the a-c voltage. In this way, electrons and their secondary descendents can be made to bounce back and forth between the plates and multiplication takes place. The necessary phase relationships between the electrons and the field are discussed. The multipactor described here uses 10 cm microwave power to get the a-c voltage. It has been used as a γ-ray detector in which case the cavity is "broken down" by the multiplication of a Compton electron ejected from the cavity wall by a γ ray. This breakdown gives rise to a microwave pulse several mv high at a crystal rectifier. The efficiency of this process is about 1.5×10^{-5} count/γ

ray. The rise time of the pulse is calculated to be about 5×10^{-10} sec and is measured to be less than 10^{-7} sec. The deadtime is presumed to be about 5 μsec.

494 The He^3 Isotope. K. A. Tumanov. Uspekhi Fiz. Nauk 37, 405-13(1949) (in Russian).
This is a review of works on He^3. Of the 23 references given, five are Russian, all the others being American. The methods of separation of He isotopes are briefly discussed, in connection with the super-fluidity phenomena, the distribution of isotopes between the liquid and the solid phases, and the osmotic properties. The cryogenic and the thermodiffusion methods of separation are those mentioned.

495 On Gas-Centrifuges (Summary). K. Beyerle, W. Groth, P. Harteck, H. J. D. Jensen, G. Beggerow, V. Faltings, A. Suhr, and E. Nann. Chemie-Ingenieur-Technik 21, 331-5(1949) Sept. (in German).
Details of construction are reported of a centrifuge consisting of many chambers. The operational efficiency of the apparatus is discussed for xenon, krypton, and selenium isotopes, which were used for the purpose of calibration, and for uranium hexafluoride. It is shown that by adding hydrogen to the isotope mixture in the centrifuge, harmful turbulence effects are avoided, so that the separation efficiency is increased.

496 Retardation of High Velocity Ions in Gases. A. J. Dempster and A. E. Shaw. AECU-638(UAC-163), Oct. 3, 1949. 1p.
The document is in abstract form; it is reproduced below in its entirety.

In connection with the measurement of the masses of isotopes with a double focusing mass spectrograph using 8,000 volt ions, it was observed that differences in the spacing of narrow doublets occur when small amounts of gas are present. The differences are no doubt due to different retardations of the ions in the residual gas, and from the doublet changes it is possible to deduce the energy losses, even when they are only 2 parts in 100,000 or 0.16 volts in the 8,000 used. At pressures of 10^{-5} mm the singly charged NO^+ ion was retarded 1.05 volts more than the doubly charged nickel ions. At higher pressures when benzene was introduced to give comparison lines, energy losses in Sm^{+2} and Sm^{+3} ions were as much as 16 volts more than in the corresponding hydrocarbon ions. With quadruply charged samarium ions an unexpected phenomenon was observed—two ionic types of the Sm^{+4} isotopes are formed. One suffers very large energy losses compared with the other, up to 58 volts, and is strongly scattered, while the second type of Sm^{+4} isotopes remain as sharp as at zero pressure.

497 General Purpose Mass Spectrometer. Metropolitan-Vickers Electrical Company Ltd. March 1949. 11p. (NP-1023).
The design details and characteristics are given for the Metrovick general purpose mass spectrometer which comprises a tube unit, a control unit, and a recorder. The tube unit and control unit together form a complete mass spectrometer for manual operation. This instrument has been designed so as to be readily adaptable tc five major classes of research problems or routine analysis, as follows: (1) determination of abundance ratios of stable isotopes, (2) investigation of products of ionization and dissociation of molecular gases, (3) analyses of organic gas and vapor mixtures, (4) general gas analyses, and (5) reaction kinetics. Included in this report is a provisional leaflet describing a limited-range mass spectrometer for use primarily in determination of abundance ratios of stable isotopes in the mass range 1-70. It comprises a tube unit and control unit which together form a complete mass spectrometer for manual operation. The construction of the instrument allows it to be used for routine isotopic tracer work by operators of moderate experience. At the same time, the needs of physical research have been borne in mind, and the instrument may readily be adapted to a wide variety of research problems.

498 Could You Use a Mass Spectrometer? James C. Neerman and Odon S. Knight. Chem. Eng. 56, 125-7 (1949) Nov.
The authors describe the use of the mass spectrometer in their plant, Commercial Solvents Corp., at Terre Haute, Indiana. Its use has resulted in better quality control of nitroparaffins, acetone, methanol, and dimethyl ether; improved design of columns used to separate and purify nitroparaffins; higher yields of ammonia in gas synthesis plant, and accelerated research on penicillin.

499 A Simplified Emission Regulator for Mass-Spectrometer Ion Sources. E. B. Winn and Alfred O. Nier. Rev. Sci. Instruments 20, 773-4(1949) Nov.
A simplified electron emission regulator has been developed which operates by controlling the space current instead of the filament heater current. No vacuum tubes are used, but the performance is comparable with that of electronic regulators now in use.

500 Eigenvalue Problems Related to the Laplace Operator. D. A. Flanders. AECU-642(UAC-175), nd. 11p.
An approach is made to several differential eigenvalue problems of a complex nature by means of obtaining approximate solutions by algebraic processes based on the finite difference approximations to the differential operators (Laplacians). The general problem is considered; and the following specific applications are very briefly described: a two-dimensional, one-group, one-region problem; a three-dimensional, one-group, one-region problem; and a two-dimensional, two-group, two-region problem.

501 Jahnke-Emde, Tables of Higher Functions. Revised by Fritz Emde. Leipzig, Teubner, 1948. 4th ed. 300p. (in German).
The 4th edition of these well known tables contains the following new materials: extension of the tables of the error

integral, tables of the functions of the parabolic cylinder, of Laguerre functions, of spherical harmonics of the second kind, of the incomplete cylinder functions of Anger and of Weber, of the cylinder functions $J_{n/3}(iy)$ and $H^1_{n/3}(iy)$ (n = 1.2), formulas and figures to explain the use of Debye series for cylinder functions of complex argument and index, and a bibliography of tables of logarithms with seven or more places. The text of the tables is both in German and in English.

502 Reflection and Polarization of Neutrons by Magnetized Mirrors. D. J. Hughes and M. T. Burgy. AECU-596(UAC-156), nd. 5p.

The refraction of neutrons in magnetic materials by means of critical reflection from ferromagnetic mirrors has been studied. Results of studies which show that the critical angle observed with the mirror magnetized in the direction of neutron propagation is sensitive to the assumed form of the neutron-electron magnetic interaction and can be used to decide the correct form are reported. It is also shown that completely polarized neutrons can be obtained by reflection from magnetized cobalt without the necessity of monochromatization because only one spin state will reflect regardless of neutron wavelengths.

503 The Neutron-Proton Interaction. R. S. Christian and Edward W. Hart. AECU-606(UCRL-384, Revised), Sept. 21, 1949. 46p. (See also AECU-392).

The purpose of the present paper is to ascertain whether it is possible to determine a phenomenological description of the neutron-proton interaction in terms of a potential. A further aim is to determine with what uniqueness this potential can be determined from the present experiments, particularly those at high energies. The program consisted of assuming a number of potential models so adjusted that they fit the low energy region and correlating the high energy scattering with the various features of each model. The following conclusions were reached:

1) Exchange character. If the potential has approximately the same radial dependence in all states (i.e., even an odd parity, singlet and triplet) and the range is chosen within acceptable limits, it is concluded that for a good fit a = 0.55 ± 0.05 or, alternatively, the depths of odd potentials, V_{odd}, must satisfy the relation $O > ({}^1V_{odd}) + ({}^3V_{odd}) > -({}^3V_{even})$.

2) Radial dependence. The $(1 + P_x)/2$ potentials, when compared for equal effective ranges differ by at most a factor of 2 in the total cross section or in the ratio $\sigma(180°)/\sigma(90°)$. However, these differences may be correlated with general shape features. Further, the experiments are adequate to distinguish among the potential shapes.

a) A long-tailed potential is necessary to explain the large scattering from the higher angular momentum states at 40 Mev without violently affecting the 90-Mev scattering. On this basis the square and gauss potentials are unacceptable while the exponential and Yukawa potentials are allowable.

b) The Yukawa potential, because of its singular nature, predicts high total cross sections (approximately 20-30% higher than the best experimental value) for any combination of ranges. The exponential potential for approximately the same angular dependence predicts cross sections 10-20% lower, however, the detailed fit of the angular distribution is poorer. Both are acceptable, however, with the present experimental uncertainties.

The best fit for these potentials is (assuming the same range for all the forces) $R = 0.75 \times 10^{-13}$ cm (exponential), $R = 1.35 \times 10^{-13}$ cm (Yukawa). (For calculations, where the tensor force is unimportant a central force model with a Yukawa range of 1.18×10^{-13} cm can be used.)

c) The shape of the angular distribution about 90° is evidence of a tensor force in scattering. Here, with a $1/2(1 + P_x)$ dependence, a purely central force, yields a flatter distribution than an interaction including tensor forces. The latter distribution agrees significantly better with experiment.

3) Singlet range. The total cross section measurements imply a singlet effective range greater than 2×10^{-13} cm. A long singlet range is further favored by the angular distribution. Low energy scattering yields only the requirement that the singlet range be less than 3×10^{-13} cm.

4) Triplet range. The low energy limits on the effective range are $1.53 \pm .20 \times 10^{-13}$ cm. The determination of the limits on the range from high energy scattering depends upon the explicit model used, but for all models considered it has been found to be within the above limits.

5) Tensor force range. The tensor range may be increased relative to the central range by as much as a factor of 2 without adversely affecting either the low or high energy results.

504 Calculation of Shielding Properties of Water for High Energy Neutrons. Preston C. Hammer. AECU-630 (LADC-717), nd. 6p.

The problem of determining the shielding effectiveness of a 100 cm thick wall of water to 14-Mev neutrons normally incident upon it has been formulated and calculated by the Monte Carlo statistical method. The calculation was simplified by use of a random number deck compiled by Rand Corp., a natural logarithm deck, and IBM machines. The method of setting up the calculation is outlined in this report.

505 Neutron Density in Two Adjoining Media. B. Davison. TN-8, nd. 8p.

This report consists of a mathematical development of formulas for determining the angular distribution of neutrons leaving one medium and entering the second medium. The conditions state that the neutrons come in an infinite number from the infinity in the first medium, and that their density vanishes at infinity in the second medium.

506 On the Integration of the Integro-differential Equation Governing the Phenomenon of the Diffusion of Thermal Neutrons. C. Agostinelli. Atti accad. naz. Lincei.

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Classe sci. fis. mat. e nat. 5, 140-3(1948) Sept.-Oct. (in Italian).
A definite integral is obtained as the solution of the integro-differential equation governing the phenomenon of the diffusion of thermal neutrons.

507 On the Relativistic Correction for Some Diffusion Problems. Mircea Drăganu. J. phys. radium 10, 301-4(1949) Oct. (in French).
An article of similar content appeared in Compt. rend. 228, 367-370(1949) Jan. 31, under the title, On the relativistic generalization of the integral-differential equation for the diffusion of neutrons. An abstract of the article has been listed in Nuclear Science Abstracts as abstract No. 3-402.

508 Radioactive Decay of the Neutron. Yu. V. Sivintsev. Priroda, No. 5, 37-8(1949)(in Russian).
This is a short note on the radioactive decay of neutrons, predicted by the Fermi theory. Possible methods for the discovery of such a decay are enumerated, and an account is given of the recently made preliminary experiments on the subject (Snell et al, Phys. Rev. 74, 1217(1948)). 10 references.

509 Design and Construction of the Bevatron Quarter Scale Operating Model. W. M. Brobeck. AECU-627 (UCRL-464), Aug. 22, 1949. 48p.
This report summarizes the work on the model bevatron (proton synchrotron) from the initial decision to construct one (July 20, 1948) to the first beam obtained from the bevatron (Apr. 30, 1949).

510 Measurement of Betatron Guiding Fields During Electron Ejection. E. C. Gregg, Jr. Rev. Sci. Instruments 20, 841(1949) Nov. (Laboratory and shop note).
For many reasons it is important to know the value of the magnetic field in a betatron, as a function of radius and time. This may be accomplished by means of a probe coil, movable along a radius, and connected through an integrating circuit to an oscilloscope with linear sweep. The scope pictures may be photographed for convenience.

511 Quarter-Wavelength Coaxial-Line Resonators for Betatron-Started Synchrotrons. F. K. Goward, J. J. Wilkins, L. S. Holmes, and H. H. H. Watson. Proc. Inst. Electrical Eng. 96, Pt. III, 508-16(1949) Nov.
The paper describes the design of quarter-wavelength coaxial-line resonators, suitable for use in betatron-started synchrotrons giving energies less than 400 Mev. The description is illustrated by measurements on the resonators which have been incorporated in 8-Mev and 30-Mev synchrotrons.

512 A Spectrometer for the 4-Mev Linear Electron Accelerator. J. G. Thomason. Atomic Energy Research Establishment Report No. AERE-G/R-217, Oct. 7 1948. 20p.
The spectrometer described produces a display in the form of an energy-intensity graph for a beam of electrons having energies up to 5 Mev. The electron beam is deflected by the modulated magnetic field from an iron-cored electromagnet before being collected in a Faraday cup. Circuits are described for generating the current sweep in the magnet energizing coils and for lengthening the voltage pulses received from the head amplifier connected to the Faraday cup leak resistor. An a-c voltage amplifier having negligible phase distortion at a frequency of 9 cps is described, and an account of how the display is produced on a long-afterglow cathode-ray tube is given.

513 A Statitron for a Small Nuclear Laboratory. D. R. Inglis, R. W. Krone, and S. S. Hanna. Rev. Sci. Instruments 20, 834-5(1949) Nov. (Laboratory and shop note).
This small statitron (Van de Graaff generator) is similar in its main features to instruments described previously (Trump and Van de Graaff, Phys. Rev. 55, 1160(1939); Herb et al, Phys. Rev. 58, 580(1940)), but a few new details have been incorporated. The single high potential electrode is supported from only one end in cantilever fashion and the column of equipotential hoops is of uniform diameter throughout. This cylindrical array permits standardization of the hoops and leaves more room in the pressure tank than the conical array. Other structural features have also been slightly modified.

514 Cyclotron Design. Swiss Patent 244,180. March 17, 1948.
This invention claims to increase the number of particles which leave the cyclotron with maximum energy and decrease by 2-3% the magnetic field from the center to the outside of the accelerating chamber. This is done by varying the frequency of the alternating current according to a sawtooth-shaped pattern; better focusing of the charged particles is also obtained. It is stated that the maximum frequency of the alternating current should correspond to the frequency of the particles at the center of the chamber, while the minimum frequency should be equal to the frequency of the particles having acquired maximum velocity.

515 100-Ton Test: Piezo Gage Measurements. R. L. Walker. AECD-2747, June 22, 1945, Decl. Nov. 2, 1949. 26p.
The piezo gage system used at the Trinity May 7 shot, 108 tons TNT equivalent, is explained. Data on the air blast as measured by these gages are given, including maximum pressure, impulse, and duration as a function of distance from the charge. These data are compared with curves compiled by Sheard, Littler, and Kennedy showing results to be expected from 108 tons TNT in the light of measurements on smaller bore charges.

516 Vapor Pressures of He^3 and of He^3 - He^4 Mixtures. D. W. Osborne, B. M. Abraham, and B. Weinstock. AECU-601(UAC-150), nd. 2p.

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The document is in abstract form; it is reproduced below in its entirety.

The vapor pressure of pure He^3 was measured from 1.025°K to 3.45°K. Two identical 0.05-cc copper bulbs were used, which were silver-soldered together to ensure their being at the same temperature. These were connected to the manometers and filling line by 0.5-mm ID monel tubes. Pure He^3 was condensed in one bulb and pure He^4 in the other. The temperature was obtained from the vapor pressure of He^4, using the Bleaney and Simon 1939 scale below 1.5°K and Kistemaker's deviations from the Leiden 1937 scale at higher temperatures. The He^3 data are accurately represented by the equation, $\log_{10} P_{mm} = -0.97796\ T^{-1} + 2.5 \log_{10} T + 0.000302\ T^3 + 1.91594$. From this equation the heat of vaporization and entropy of the liquid have been calculated at various temperatures.

Preliminary measurements of the vapor pressure of a 20.3% solution of He^3 in He^4 were made with the same apparatus. The apparent mole fraction of He^3 in the liquid was calculated from the vapor pressures of the mixture and of the pure components and Raoult's law. Appreciable deviations from Raoult's law were found at all temperatures. It was observed that above 1.89°K the apparent mole fraction was approximately 25% higher than the actual mole fraction of He^3 in the liquid phase, and that starting at about 1.89°K the apparent mole fraction increased approximately linearly with temperature to a value of 0.51 at 1.04°K. These results agree qualitatively with a model proposed by Taconis, Beenakker, Nier, and Aldrich to explain their observations of the vapor-liquid equilibrium of more dilute solutions of He^3 in He^4, but they disagree quantitatively. The transition temperature indicated by these measurements (1.89°K) is higher than that observed in super-leak experiments with the same mixture (1.63°K).

517 Viscosity of Liquid He^3. B. Weinstock, D.W. Osborne, and B. M. Abraham. AECU-632, nd. 2p.

The document is in abstract form; it is reproduced below in its entirety.

The viscosity of liquid He^3 has been determined by measuring the isothermal rate of flow of the liquid through a narrow annular channel. When the liquid is allowed to flow under its own vapor pressure, the driving force is due to a pressure arising from the surface tension and the hydrostatic head. Without an accurate knowledge of the surface tension of He^3, reliable values of the viscosity cannot be obtained in this way. To overcome this difficulty an additional driving force was applied to the liquid several orders of magnitude greater than that due to the estimated surface tension. This was accomplished by permitting the liquid to condense in the capillary on the inlet side of the channel to a point above the bath level. The resulting difference in vapor pressure between the upper and lower surfaces of the liquid could then be adjusted to supply the desired additional driving force. It can be shown that the liquid did not fill the entire length of the annulus. In order to correct for the length of the capillary occupied by the gas, the viscosity of He^3 gas was also determined. The capillary constant of the annulus was calculated from the rate of flow of He^4 gas using the known values

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of its viscosity and virial coefficients. Poiseuille's law was obeyed in all the measurements.

The viscosity of liquid He^3 determined in these experiments was found to increase from 22.0 micropoise at 2.79°K to 30.4 micropoise at 1.04°K.

Measurements of the viscosity of liquid He^4 indicate that it decreases with decreasing temperature even above the lambda temperature. Aside from the superfluidity which is exhibited below the lambda temperature, this behavior also distinguishes liquid He^4 from all other liquids. The fact that liquid He^3 shows a temperature coefficient of viscosity of the opposite sign is believed to be strong confirming evidence for the nonexistence of a superfluid transition in He^3.

518 Some Calculated Properties of Tritium. E. F. Hammel. AECU-647(LADC-727), nd. 10p.

The application of quantum theory to condensed permanent gases by DeBoer (Physica 14, 139(1948)) resulted in a modified law of corresponding states that has been successfully used to predict a number of properties of He^3 which were later confirmed by experimental data. In this paper DeBoer's modified law is applied to tritium, and vapor pressures within the temperature range 12.2 - 33.9°K, critical constants, triple-point constants, and several molecular constants have been calculated. It is believed that an even closer agreement between theoretical and experimental values will be observed when experimental data on tritium become available than was found for He^3.

519 Meeting of the German Physical Society Held at Clausthal on Sept. 9-12, 1948. Angew. Chem. 61, 151-4(1949) Apr. (in German).

Among others, abstracts of the following papers are given which were presented at the meeting of the German Physical Society held at Clausthal on September 9-12, 1948: O. Haxel, The creation of mesons; M. Kemmerich, The half-life of rubidum 87; P. Meyer, Determination of the binding energy of the deuterium nucleus and of the mass of the neutron; K. Gund, Production of a collimated electron beam with a betatron; F. Kirchner, On the value of the atomic constants; H. Glubrecht, "Hit-or-miss" interpretation of the biological effect of radiation. R. C. Evans, Neutron diffraction in crystals, O. Osberghaus, On the use of mass spectrometers to find leaks in high vacuum apparatus; G. W. Oetjen, Problems of high vacuum technique.

520 On the Anomalous Electrical Properties of the Sesquioxide of Vanadium between -100°C and +300°C. Marc Foëx. Compt. rend. 229, 880-882 (1949) Nov. 2 (in French).

In previous work (Compt. rend. 223, 1126(1946)) it has been shown that V_2O_3 undergoes a transformation at about -100°C, which produces an anomaly in the relation between resistance and temperature. Below this point the resistance decreases with increasing temperature (the normal behavior for semiconductors). From -100°C to +300°C the resistance increases with temperature and above this point it falls off

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again. Data has been obtained for temperatures up to 1,100°C and a resistance temperature curve is given. The coefficient of expansion is plotted against temperature and this curve seems to indicate a second order transition at +200°C.

521 On Diffusion Affinities. J. E. Verschaffelt. Bull. classe sci. Acad. roy. Belg. 35, 559-67(1949)(in French).

In a previous article (Bull. classe sci. Acad. roy. Belg. 35, 285(1949)) the author treats the effects of physico-chemical forces on the diffusion equations. These considerations are then applied to the thermo-mechanical theory of electrical and heat conduction. The present article contains several simplifying assumptions as to the nature of the physico-chemical forces which greatly simplify the calculation of the Thomas and Peltier coefficients.

522 Proceedings of the Physical Society in Bavaria. Meeting, July 29 - Aug. 2, 1949, at Munich. Physik. Blätter 5, 426-38(1949)(in German).

Among others, abstracts are given of the following papers read at the meeting: The Exact Measurement of Inhomogeneous Fields Due to X-rays and Radium Sources, H. A. Bomke. Isotope Separation by Gaseous Diffusion, W. Groth.

523 Introduction to Theoretical Nuclear Physics. H. Dänzer. Karlsruhe, Braun, 1948. 186p. (in German).

The rectangular potential-well model and the liquid-drop model of the nucleus are described in detail. On the basis of these models various nuclear phenomena are discussed, among them fission, nucleon evaporation from nuclei, γ-emission, the deuteron photo-effect, α decay, and the scattering of nucleons by nucleons.

524 Proceedings of the Physical Society in the British Zone [of Germany]. Meeting held on 22-24 April, 1949, at Hamburg. Physik. Blätter 5, 228-36(1949) (in German).

Among the papers presented at this meeting were the following: On Inelastic Scattering and the Energy Loss Associated with It of Fast Neutrons in Lead, F. G. Houtermans and M. Teucher. Disintegration of the Deuteron by Collision with an Electron, W. Paul. Interpretation of the "Magic Numbers" in the Structure of Nuclei by Means of a Special Model, O. Haxel, H. Jensen, and H. Suess. The Photographic Effect of Protons of Medium Velocity, P. Brix and H. G. Dehmelt. Total Reflection of an Atomic Beam at the Edge of a Magnetic Field, H. Friedburg and W. Paul. The Influence of Magnetic Fields on the Velocity of Diffusion in Oxygen, H. Senftleben and H. Schult. On the Origin of the Radio-Frequency and of Cosmic Radiation in the Milky Way, A. Unsöld. Interstellar Magnetic Fields and Cosmic Radiation, A. Schlüter. Slowing Down and Diffusion of Cosmic Ray Neutrons in the Atmosphere, E. Bagge and K. Fincke. Gas Centrifuges Stabilized by Hydrogen, W. Groth and P. Harteck.

525 Proceedings of the Physical Society of Wuerttemberg-Baden. Meeting held on 30-31 Jan., 1949, at Heidelberg. Physik. Blätter 5, 178-85(1949)(in German).

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Among the papers read at this meeting were the following: Production of Mesons, O. Haxel. On Varitrons, a Short Report Concerning Russian Work on Cosmic Rays, A. Papkow. On the Component of the Cosmic Radiation Producing Nuclear Disintegrations, Erwin Schopper. On the Interaction of Mesons of the Cosmic Radiation with Atomic Nuclei, K. H. Höcker. Measurement of the Mass of the Mesons, Ch. Peyrou. (γ,n) and (n,2n) Cross Sections and Nuclear Structure, P. Jensen. Energy Distribution of Scattered Electrons, W. Bothe. Measurement of Thorotrast in Organic Tissue, H. Maier-Leibnitz, K. Schmeiser, and M. Schwaiger. On the Kinetics of Droplet Formation on Negative and Positive Ions in a Wilson Cloud Chamber, M. Pollermann. Counting of Elementary Particles and Quanta with Electron Multipliers and a Scintillating Screen, E. Fünfer. Theoretical Remarks Concerning the Statistics of the Electron Multiplier, F. Sauter. Bremsstrahlung Yield and Back Diffusion in Light Elements, H. Zolg.

526 Several Chemical Aspects of Nuclear Physics. Marcel Guillot. Rev. gen. sci. 61, 161-7(1949) (in French).

After a short discussion of the mass charge and spin of nuclei, the nuclear structure is briefly described. Objections to the proton-electron theory are mentioned, and the proton-neutron theory is introduced. This leads to an exposition of the various theories of nuclear forces, to a discussion of radioactivity and isomeric states, and finally to a general description of nuclear reactions. The author then describes fission and chain reactions in uranium. He concludes with several remarks on the actinide groups.

527 Scintillation Counter Symposium (Sponsored by Oak Ridge National Laboratory, June 3 and 4, 1949). Comp. by W. H. Jordan. AECU-583, Oct. 21, 1949. 63p.

This report is divided into the following sections: Scintillation Counters, by H. Kallmann; Electron Multiplication in Crystals, by F. Seitz; Photomultipliers for Scintillation Counters by G. A. Morton; Scintillation Spectrometer, by P. R. Bell; Notes on the Second Day of the Scintillation Conference, by W. H. Jordan.

528 Range Energy Relation for Protons in Nuclear Emulsions. Hugh Bradner, Frances M. Smith, Walter H. Barkas, and A. S. Bishop. AECU-589 (UCRL-443), Sept. 9, 1949. 17p.

An experimental range-energy relation in Ilford C-2 emulsion has been obtained for protons up to 39.5 Mev. In the region from 17 to 33 Mev the relation for dry emulsion is fitted by the empirical equation $E_{(Mev)} = 0.251\ R_{(\mu)}0.581$. Variations in water content due to changes in atmospheric humidity make several per cent difference in range. The range in Ilford glass is found to be 18 ± 4% longer than in dry C-2 emulsion.

529 Portable Fast Neutron Survey Meter. G. S. Hurst. AECU-613(ORNL-485), Nov. 2, 1949. 10p.

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A test model of an instrument capable of detecting neutron fluxes (0.1 - 10 Mev energy) ranging from 10 - 10,000 neutrons/cm²/sec has been constructed. The basic elements are a recoil proportional counter, a single stage amplifier, and a thyratron rate meter circuit. In its present form, the instrument is insensitive to γ-ray (radium) intensities less than 1 r/hr. A decided advantage of this instrument is the small physical size of the single detecting unit. Details of construction and circuit diagrams are included.

530 Personnel Protection Gamma Radiation Meter. Richard J. Watts. AECU-620(LADC-728), nd. 9p.
A simple, rugged instrument for the detection of γ radiation in the range 0.05-100 r/hr is described. Features of the instrument are use of the least possible number of components, ease of battery replacement, and complete waterproofing obtained by the use of a lucite faceplate. The components include an ionization chamber, an electrometer tube, a microammeter, and a modified cathode follower circuit for impedance conversion. Calibration and performance are given. This instrument is intended only for rough measurements where poor accuracy is acceptable.

531 Final Engineering Report Covering Austin Beta-Gamma Hand and Foot Checker. Austin Company. AECU-644(M-4441), Nov. 9, 1949. 27p.
This final report discusses the objectives sought and the manner in which they were attained in connection with the design and manufacture of the Austin Beta-Gamma Hand and Foot Checker. Basically, the work included a study of similar devices, development and tests of desirable improvements, design and detail drafting, production, and performance tests. The general requirements specified that the equipment be of rigid construction, easy to keep clean, and readily accessible for testing and servicing. Improvements incorporated to conform the equipment to modern production methods, as well as practical changes to achieve automatic operation, increased stability, and to facilitate and simplify maintenance procedures are covered in detail. The report also includes photographs and a schematic diagram of the final product.

532 Luminescence Measurement of the Roentgen Dosage Field of a Beryllium Window Tube. Benedict Cassen and Lawrence R. Curtis. AECU-646(UCLA-39), Nov. 8, 1949. 15p.
It has been found experimentally that certain polymerized optically clear plastics, notably polyvinyl carbazole, luminesce under roentgen rays so that their brightness as measured by a photomultiplier tube is apparently approximately proportional to roentgen unit intensity over a wide intensity and voltage quality range. The fluorescence of a small grain of this plastic has been used to plot, with a high degree of spatial resolution, the roentgen dosage field around and at the window of a 50-kv beryllium-window x-ray tube. The maximum local intensity obtainable at 50-ma full-wave tube current was about 276,000 r/min.

533 Pulse Type Regulated High Voltage Supply for G. M. Tubes. Richard J. Watts. AECU-648(LADC-713), nd. 10p.

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A 1000-volt variable voltage supply for incorporation in a chassis with a GM tube is described. This instrument has the advantages of small size, economy in cost, and utilization of standard parts throughout. Ripple at 1000 v is 80 mv. Regulation curves are included.

534 An Automatic Timer for Radioactivity Measurements. Brian D. Corbett and A. J. Honour. Electronic Eng. 21, 341-5(1949) Sept.
The authors describe an instrument designed to carry out automatically the timing operation of radioactive material in conjunction with one of the commercially available electronic scalers developed by the Atomic Energy Research Establishment. Three circuit diagrams are shown. They are, clock and register circuits, pulse counting circuits, and timing and control circuits. The timing accuracy and other considerations are briefly discussed.

535 Characteristics of Chalk River Ion-Chambers Types TPA, TPD, and TPJ. B.S. Smith, C.O. Peabody, and D.S. Craig. CRTec-402, nd. 38p.
Data, supplementing that found in Canadian report MTec-168, are given on the saturation characteristics and current sensitivities of the TPA, TPD, and TPJ type ion chambers. These data have been compiled from day to day manufacturing and testing records. The test procedures used are discussed.

536 Coincidence Arrangements for Scintillation Counters. K. P. Meyer, E. Baldinger, B. Hahn, and P. Huber. Helv. Phys. Acta 22, 420-424(1949)(in German).
Scintillation counters are characterized by a broad amplitude distribution of the pulses, and by a considerable null-effect for coincidence arrangements at room temperature. This considerably influences the rate of coincidence counting. The authors describe circuits, involving the use of RCA 931 A photomultiplier tubes, by means of which these disturbing influences can be minimized.

537 Fast Neutron Detector. W.G. Moulton and C.W. Sherwin. Rev. Sci. Instruments 20, 766-7(1949) Nov.
A simple fast neutron detector suitable for health physics applications has been constructed using two 931A photomultiplier tubes in coincidence to reduce background. A "sandwich" made of Lucite and activated zinc sulfide is used to produce the scintillations. The efficiency of the instrument for fast neutrons from a Ra-Be source is $1.5 \pm 50\% \times 10^{-4}$ It detects a fast neutron flux of 20 neutrons/cm² sec with a counting rate that is greater than ten times background.

538 Ion Chamber Data. H. Carmichael. CRTec-382, Aug. 17, 1945. 21p.
The operational characteristics of all the large ion-chambers that have been designed for the Petawawa Plant are discussed. In the case of the chambers for safeguarding personnel, the ion currents corresponding to the biological toleration intensities of γ rays, fast neutrons, and slow neutrons are deduced.

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539 New Method for Investigating the Absorption Spectra of Crystallophosphors. E. M. Brumberg and F. M. Pekerman. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz. 13, 218-23(1949)(in Russian).

The difficulties involved in the determination of absorption spectra of crystalline powders caused Vavilov to propose the use of the ultraviolet-light ultra-microscope, provided with a special spectrographic adaptor, for the study of a single small crystal (Izvest. Akad. Nauk, Ser. Fiz. 6, 32(1942)). In this way the diffused scattering inherent in powders is avoided, and the use of very thin crystals permits the exploration of the far-ultraviolet region of the spectrum. Using this procedure, absorption spectra of ZnS, ZnS-Cu, ZnS.CdS, and ZnS-Mn phosphors were measured in the wavelength range 405-254 mμ. Microphotograms of these spectra are given.

540 The Photographic Effect of Moderately Fast Protons. Peter Brix. Z. Physik 126, 35-48(1949)(in German).

Darkening curves, obtained with 2.6-7.0-kev protons acting upon Agfa-Autolith photographic plates, showed, for weak darkenings, a characteristic bulge. This feature is explained as due to direct hits of the emulsion grains by protons, within the latters' range, while the further rise of the darkening curve, which follows the bulge, is ascribed to secondary processes. It is shown that, within the region of the "primary darkening," the phenomenon involved is a "one-hit" process, whose efficiency is about equal to one. As to the region of the "secondary darkening," the corresponding curve is similar to that produced by light, and the average number of protons necessary to make an emulsion grain developable, is about 10^5. The author recommends a similar discrimination between the primary and secondary processes in the analysis of the existing material on the darkening produced in photographic plates by ions heavier than the proton.

541 Portable Ionization Chambers for Measuring Injurious Radiations in X-ray and Radioactivity Laboratories. Lucien Mallet and Robert Maurin. Compt. rend. 223, 238-40(1946)(in French).

Harmful stray radiations, electromagnetic or corpuscular, are detected and measured by portable ionization chambers consisting of (1) a condenser charged to a definite potential at the beginning of each working period (e.g., a day), one of the electrodes being grounded, and (2) the ionization chamber proper, filled with air or a gas mixture and fed from the condenser during the working period. At the end of that period the remaining potential of the condenser gives information about the quantity of the injurious radiations. The instrument is placed in the laboratory or carried by the personnel. Three different sensitivities (several r, 1 r, and 0.1 r) are obtained by increasing the distance between the electrodes of the ionization chamber proper.

542 Pulse Counter with a Scaling Circuit. S. I. Kaplanskiĭ and A. A. Ryabov. Zhur. Tekhi. Fiz. 19, 634-6(1949) (in Russian).

A scaling device for pulse counters is described, giving scaling ratios 2, 5, 10, 20, and 40, and presenting the advantage of considerable simplicity of the circuit as compared with the current instruments, (three electronic tubes instead of 12-15). The working principle is that described by Johnson (Rev. Sci. Instruments 9, 218(1938)): a condenser is charged by successive additions of equal quantities of electricity; this is followed by a discharge through a neon bulb when the necessary potential difference is reached; the desired scaling ratio is obtained by regulating the capacity of the condenser. The principal part of the circuit is a two-tube multivibrator furnishing strictly equal, almost rectangular, pulses.

543 Shrinkage of Photographic Emulsions for Nuclear Research. J. Rotblat and C. T. Tai. Nature 164, 835-6(1949) Nov. 12 (Letter to the editor).

The shrinkage caused by the washing-out of the silver halide in nuclear photographic emulsions necessitates multiplication of the track length observed by a factor S, the shrinkage factor. Data on the shrinkage factor were obtained by means of direct measurements of thicknesses in various types of emulsions with different loadings, concentrations of gelatins, thicknesses, and under different conditions of development fixing and washing. The results obtained indicate that the shrinkage factor roughly follows the ratio of the total volume of the emulsion to that of the gelatin, although it is always smaller than that ratio. For emulsions of normal composition it was found that Ilford C2, E1, G5, and Kodak NT-1a, NT-2a, and NT-4 emulsions give nearly the same shrinkage factor, i.e., $S = 2.7 \pm 0.2$, the limits being extreme values and including measurements on emulsions from different batches. For lithium-loaded emulsions S may go up to 3.2, due to the washing out of the lithium sulphate. Increasing the strength of the developer, or the time of fixation or washing, increases the shrinkage factor; but the changes in S are less than 10% even for wide variations of processing conditions. Lithium-loaded emulsions (Ilford C2 and E1) were exposed to thermal neutrons and curves were obtained for the number of tracks as a function of the angle of dip. The results obtained indicated that the shrinkage of the emulsion is uniform throughout its depth and that the directly measured shrinkage factor can be used for the correction for shrinkage, at least for small angles of dip. In addition, data were obtained on the horizontal and vertical projections of the tracks for various angles of dip using the aforementioned arrangement as well as for thorium C′ (Po^{212}) α particles in plates loaded with thorium (B + C′)(Pb^{212} + Po^{212}) in order to observe the effect for large angles. From the results it is concluded that the multiplication of the depth measurement by the shrinkage factor is permissible only for angles of dip up to 25-30° in the case of heavily ionizing particles. For larger angles a smaller correction has to be applied, its value depending on the grain spacing in the track.

544 Statistical Theory of Errors in Measurements with an Ionization Chamber. I. Ya. Barit and M. I. Podgoretskiĭ. Zhur. Tekhi. Fiz. 19, 730-42(1949)(in Russian).

Using a kinetic equation, the statistical regularities in the work of an ionization chamber are examined. A calculation is made of the momenta and of the distribution function of the

current in the chamber. The computation manipulations on the results of a series of successive measurements are outlined. As a special case, a circuit is studied that includes an inertia-possessing instrument.

545 Statistics of Counting Losses in Operations with Scaling Circuits. I. Ya. Barit, M. I. Podgoretskiĭ, and A. E. Chudakov. Zhur. Tekhi. Fiz. 19, 722-9 (1949)(in Russian).

Formulas are derived for the computation of the number of omissions due to "dead time," in operations with counters working in combination with scaling circuits. A separate analysis is first made of the dead time in the work of the counting device, and of that in the functioning of the multivibrator; then, a formula is given for the case of simultaneous presence of these two error sources. Critical remarks are made on the work of Berlovich on the same subject (Zhur. Eksptl. i Teoret. Fiz. 16, 543(1946)).

546 Theoretical Study of Voltage Pulses from Ionization Chambers. P. Billaud. J. phys. radium 10, 277-85 (1949) Oct. (in French).

By means of functions representing the motion of the ions in the field it is possible to study theoretically the pulses produced in a chamber of arbitrary geometry. Certain laws are established according to which one can obtain information from an examination of pulses about ionizing particles producing them, especially the particle energy and direction with respect to the field.

547 Detection of Emanations from Materials and Measurement of the Volumes Thereof. Thomas G. Hieronymus. U.S. Patent 2,482,773, Sept. 27, 1949.

This invention relates to the detection and measurement of the intensity or quantity of radiation of any of the known electro-chemical series of elements, or combinations thereof, whether in solid, liquid, or gaseous form at ordinary room temperature and without special treatment. The apparatus described operates on the principle that each of the known elements releases a particular quantity of emanations per unit time and at a fixed temperature and has particular electrical and optical characteristics and frequencies. The purpose of the apparatus is to identify the elements by an analysis of the radiations; the radiations are impressed on a conductor and transmitted through a tunable circuit to an electrode from which they emanate and are focussed through a refracting body unto a second electrode which amplifies them.

548 Electrical Measuring Apparatus. Ole Landsverk and Ernest O. Wollan (to the U.S. Atomic Energy Commission). U.S. Patent 2,465,886, March 29, 1949.

An improved electroscope for use in portable instruments measuring radioactivity is described. It is claimed that the instrument is stable, rugged, and reliable, yet sensitive. The rate of discharge of the electroscope is observed through a microscope, the light source of which may be made to flash

after a predetermined interval; a timing means is adapted to indicate visually on an indicator the passage of a fixed time after its actuation.

549 Ionization Chamber. J. Howard Parsons (to U.S. Atomic Energy Commission). U.S. Patent 2,458,632, Jan. 11, 1949.

This device is a means for eliminating or reducing losses in high frequency electrical circuits and, it is claimed, transmits high frequency impulses with a minimum of attenuation. It provides a low impedence input when connected to an electronic counting circuit; there is also provision for a capacity guard. The instrument consists of a pair of parallel plate electrodes spaced in confronting relationship, a hollow cylindrical casing around, which is grounded, an electronic amplifying circuit having an input coupled to the collecting electrode, and an additional electrical shielding member connected to the cathode of the amplifying circuit and interposed between the collecting electrode and the casing.

550 Ionization Chamber. Casimir J. Borkowski (to U.S. Atomic Energy Commission). U.S. Patent 2,479,600, Aug. 23, 1949.

An ionization chamber, claimed to be efficient, simple in design and easy to assemble it described. It comprises a cylindrical glass envelope having two tapered ends, one end fitted with a stopcock and the other with a glass plug; a connecting rod is centered in the plug and serves as a central collecting electrode, while conducting material coated on the inside of the chamber serves as the other electrode. A guard ring, conductive means, and appropriate insulation are arranged on the plugged end.

551 Portable Battery-Powered Alpha-Ray Counting Rate Meter of High Sensitivity. Herbert Cecil Spicer. U.S. Patent 2,462,140, Feb. 22, 1949.

The present invention, it is claimed, may be used to detect deposits of pitchblende carnotite, autunite, and other uranium-bearing ores. It consists of a Geiger-Mueller counter tube, means for generating and applying a high voltage to the tube, means for amplifying the output pulses to a predetermined level and means for rectifying the pulses and applying the rectified voltage to a shunt connected to a condenser-resistance tank circuit; the voltage is then applied across the tank circuit to the input circuit of a vacuum tube and into a microresponsive indicating instrument connected in the anode circuit of the vacuum tube. The relative rate of the receipt of the pulses is indicated by the instrument and means are provided for reading and hearing the pulse rates directly.

552 Radiation Measuring Device. Francis R. Shonka (to U.S. Atomic Energy Commission). U.S. Patent 2,465,938, Mar. 29, 1949.

An improved ionization chamber for the measurement of particles and radiations emanating from radioactive materials is described. The improvement decreases the responsive time of the instrument. The apparatus consists of

an ionization chamber circuit having a voltage supply, a direct-current electronic amplifier which has a cathode, an anode, a control electrode and an anode impedance; an input circuit is connected to the ionization chamber circuit and an output circuit adapted to produce an output voltage varying with the amount of ionization occurring in the chamber; a switch is provided for connecting the ionization chamber and voltage supply in series with the resistance. An indicator is provided to show the change in potential of the anode when the voltage supply is varied.

553 Thin-Walled Geiger-Mueller Counter. Roman Smoluchowski (to General Electric Co., a corporation of New York). U.S. Patent 2,465,821, Mar. 29, 1949.

An improved Geiger-Mueller counter is described for measuring radioactivity through a greatly extended range of energies. The apparatus is claimed to be compact and easily portable. There are a number of windows in the enclosing wall of the counter chamber of sufficiently small area so that extremely thin material may be used and still preserve the gas-tight qualities of the chamber. The windows are composed of polyvinylformal in extremely thin sheets, for which the β-radiation energy absorption is low, only about 2,000 ev/μ at 30,000-50,000 ev energy radiation. One μ is equivalent in absorption to 0.6 mm of air; the thickness of the windows is 0.5-1.5 μ and in some cases the polyvinylformal is placed over a reinforcing mesh.

554 Diffraction of Electrons Moving in Succession. L. Biberman, N. Sushkin, and V. Fabrikant. Doklady Akad. Nauk S.S.S.R. 66, 185-6(1949)(in Russian).

In real experiments on electron diffraction, powerful beams are involved. However, theoretically, the process is an intermittent one, and the wave properties belong to every single electron. An experiment is described here, in which the diffraction of intermittently released electrons is realized by using beams of very low intensity in a modified electron microscope. By spreading a strong beam, a curve of photographic darkenings, as a function of electron densities, was first obtained, with the aid of which the number of the diffraction electrons could afterwards be determined. The diffraction beam used was exceedingly weak: the mean time interval between two electrons following each other through the instrument was 2.4×10^{-4} sec, while the time spent by an electron in traversing the instrument was 3×10^4 times shorter than the mean interval between two successive arrivals of electrons at a given point of the plate; therefore, the probability of a simultaneous traversing of the instrument by two electrons was very small. The diffraction pictures thus obtained (using crystals of magnesium oxide) were identical with those produced by an intensive electron beam.

555 Experiments on the Single Scattering of Electrons. Walther Bothe. Z. Naturforsch. 4a, 88-94(1949) May (in German).

Energy bands several hundred kev in width were magnetically selected from the beta radiation of a strong RaD + E (Pb^{210}, Bi^{210}) source. The scattering of these betas in thin foils of various atomic numbers was then investigated at an average angle of 110°. The spectrum of the scattered particles was taken with a 180° spectrometer. Energy losses greater than those associated with bremsstrahlung were observed only when the foils were too thick; otherwise, no anomalous energy losses occurred (except to a slight extent in the case of the lightest elements). The observed relation between the scattering cross section and the atomic number is in agreement with Mott's (Proc. Roy. Soc. (London) 124A, 425(1929); 135, 429(1931)) formula as corrected by Sexl (Z. Physik 81, 178(1933)) and Urban (Z. Physik 119, 67(1942)), but deviates considerably from the uncorrected formula.

556 Systematics of Alpha-Radioactivity. I. Perlman, A. Ghiorso, and G. T. Seaborg. AECU-634(UCRL-446), Sept. 12, 1949. 79p.

Correlations of α-decay energies in terms of mass number and atomic number have been made for all of the α-emitting species, now numbering over 100. For each element, isotopes show increase in α energy with decrease in mass number except in the region of 126 neutrons where there is an explainable reversal. This reversal has the effect of creating a region of relatively low α energy and long half-life at low mass numbers for such elements as astatine, radon, francium, and possibly higher elements, as had been noted already for bismuth and polonium. Methods and examples of using α decay data to define the energy surface in the heavy element region are discussed. The regularities in α decay are used for predictions of nuclear properties including predictions of the β-stable nuclides among the heavy elements. The half-life vs energy correlations show that the even-even nuclides conform well with existing α-decay theory, but all nuclear types with odd nucleons show prohibited decay. The reason for this prohibition is not found in spin changes in the α emission but in the assembly of the components of the α particle, and this theory is discussed further in terms of observations made on nuclides having 2 or more α groups. Using most of the even-even nuclei to define "normal nuclear radius" calculations are now able to show the shrinkage in the regions of lead and of 126 neutrons to amount to about 10%. The much greater change in "effective radius" for bismuth isotopes can be dissociated into the effects of odd nucleons superimposed on the actual decrease in nuclear radius. The simple expression $r = 1.48\ A^{1/3} \cdot 10^{-13}$ cm seems to fit the data for the even-even nuclei outside of the region of 126 neutrons better than more complex functions. 74 references.

557 Radiation Corrections for Pair Production and Bremsstrahlung. Res Jost and J. M. Luttinger. Helv. Phys. Acta 22, 391-2(1949)(in German).

The authors indicate that they are in the process of calculating radiation corrections for pair production and bremsstrahlung for the extreme relativistic case according to the method of Schwinger. They simplify mass renormalization by the explicit introduction of a self energy operator (calculated by perturbation methods)

$$\text{const.} \int d^3x \int d^4x' \, \bar{\psi}(x)\gamma\sigma\left[\bar{D}(x-x')S^1(x-x') + D^1(x-x')\bar{S}(x-x')\right]\gamma\sigma\psi(x') + \text{c.c.}$$

rather than

$$\delta m \int d^3x \, \bar{\psi}(x)\psi(x).$$

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558 Radioactive Metal Products and Method for Manufacturing. Clarence W. Wallhausen, Harry H. Dooley, and Clayton C. Carroll (to U.S. Radium Corp., New York). U.S. Patent 2,479,882, Aug. 23, 1949.

A radioactive metal product emitting α particles is described, and the method for manufacturing this and like products is outlined. This product consists of a metallic core of powdered radium mixed with a non-reactive metal, such as gold; over the core, which is compressed and molded into the shape of a long bar, a sealing film is placed on all sides and usually consists of thin metal foil; the thickness of which is controlled by compressing and rolling the resultant product. Tight binding is essential since the sealing film must allow the emission of the α rays but prevents the escape of radioactive by-products, especially radon. If the device is to be used as a static eliminator, a backing strip can be attached and the bar can then be mounted, preferably about 1 in. from the device accumulating the static; the ionization caused by the α particle emission results in the discharge of the charge.

559 Tables of Values of e^{-x} and $e^{-\lambda t}$. H. F. Hunter. Naval Radiological Defense Laboratory Report AD-121(C), May 19, 1949. 20p.

This report presents, with short discussions, two mathematical tables of functions which have frequent occurrence in computations involving radioactive decay. Table I gives three- to five-figure values of e^{-x} for all three-figure values of x from 0.00300 to 39.9. Table II gives values of $e^{-\lambda t}$ for the known values of the decay constants, λ, which occur among the fission products, and for various values of time t.

560 On Approximate Relativistic Wave Functions and Internal Pair Formation. J. L. Jackson. AECU-611 (ORNL-476), Oct. 25, 1949. 20p.

An investigation has been made of the possibility of extending the Born approximation calculation for internal pair formation to take account of terms of order αZ, where α is the fine structure constant and Z is the atomic number of the nucleus. The major part of the work done involved a study of approximate relativistic wave functions for electrons in a coulomb field which, at infinity, are moving in a fixed direction. The results of this investigation were negative in the sense that none of the methods considered led to a way to perform the internal pair formation calculation. Herein, a review of the various approaches that were attempted and the reasons for their failure are given.

561 The Application of the Tomonaga-Schwinger Theory to the Interaction of Nucleons with Neutral Scalar and Vector Mesons. P. T. Matthews. Phys. Rev. 76, 1657-74(1949) Dec. 1.

The Tomonaga-Schwinger theory is applied to the interaction of neutral scalar and vector mesons with nucleons. The Hamiltonians are derived in the interaction representation and virtual effects are transformed away. The meson and nucleon self-energies are calculated. It is shown that they are invariant and, like the electron self-energy, can be transformed away by formal renormalizations of the meson and nucleon masses. All effects are independent of the direction of the general space-like surface in spite of the occurrence in the Hamiltonian of terms explicitly dependent on this direction.

562 The Concept of Space and the Mechanics of the Electron. Florent Bureau. Bull. classe sci. Acad. roy. Belg. 35, 542-58(1949)(in French).

It is shown that every hyperbolic partial differential equation of second order representing the wave aspect of a physical phenomenon may be associated with an important invariant expression. From this expression one can derive the Riemannian metric tensor, the four vector potential, and the differential equation representing the corpuscular aspect of the phenomenon studied. These conclusions are also valid for the first order wave equation of the electron (the Dirac equation).

563 Corrections Due to the Reaction of "Cohesive Force Field" to the Elastic Scattering of an Electron. Daisuke Ito, Ziro Koba, and Sin-itirô Tomonaga. Progress Theoret. Phys. 3, 276-89(1948) July-Sept.

The theory of the "C-meson field" (or cohesive force field) which has recently been developed (Progress Theoret. Phys. 2, 145(1947)) and used successfully to overcome divergencies in the self-energies of elementary particles, is investigated to determine whether it is capable of overcoming other divergence difficulties of quantum electrodynamics. The particular problem considered is that of the infinite cross section which is obtained in the calculation of the elastic scattering of an electron by a fixed center of force when the reaction of the electromagnetic field accompanying the electron is taken into account. This problem is of special interest because of its relation to the "infrared catastrophe." Since the C-meson in Sakata's theory has approximately the same mass as ordinary mesons, the correction due to the reaction of this new field certainly converges in the low frequency limit, and there is no fear as to the reappearance of the infrared catastrophe. Thus, the point to be investigated is whether the divergence in the ultraviolet region can be eliminated by introducing this new field. The perturbation method is used when taking into account the relativistic effects and the discussion is limited to the e^2-f^2 approximation. (A calculation of this type was previously reported by Dancoff (H. A. Bethe and J. R. Oppenheimer; Phys. Rev., 70, 451(1946)), but the results obtained were given briefly and contained serious oversights). By means of a preliminary discussion it is noted that a finite correction to the cross section will be obtained if the cohesive force field is introduced as well as the positron-theoretical subtraction. The scattering process is reformulated and owing to the introduction of the cohesive force the self-energy of the electron is found to be convergent, so that the energy-level shift is finite.

564 The Effective Cross Section for Nucleon-Nucleon Collisions in the Super-Multitemporal Theory (Pseudo-Scalar Meson). Maurice Jean and Jacques

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Prentki. Compt. rend. 229, 171-3(1949) July 18 (in French).

The effective cross section for nucleon-nucleon collisions has been calculated for any reference system (to the first Born approximation) using the super-multitemporal theory recently introduced by various investigators, applied to the pseudo-scalar meson field. It is noted that the angular distribution is very sensitive to the charge-nature of the theory used, i.e., neutral or charged.

565 The Exact Transition Probabilities of Quantum-Mechanical Oscillators Calculated by the Phase-space Method. M. S. Bartlett and J. E. Moyal. Proc. Cambridge Phil. Soc. 45, 545-53(1949) Oct.

The "phase-space" method in quantum theory is used to derive exact expressions for the transition probabilities of a perturbed oscillator. Comparison with the approximate results obtained by perturbation methods shows that the latter must be multiplied by an exponential factor exp $(-\epsilon/\hbar\omega)$, where ϵ is the nonfluctuating part of the work done by the perturbing forces; as long as ϵ is small, exp $(-\epsilon/\hbar\omega) \sim 1$ and only dipole transitions have an appreciable probability. As the perturbation energy increases, however, this is no longer true, and multipole transitions become progressively more probable, the most probable ones being those for which the change in energy is approximately equal to the work done by the perturbing forces.

566 A Note on the Stopping of Fast Charged Particles in Metallic Conductors. R. Kronig. Physica 15, 667-70 (1949) Aug.

In 1943 Kronig and Korringa (Physica 10, 406, 800(1943)) proposed a theory of the stopping of fast charged particles in metals in which the lattice of the metal ions was replaced by a positive background with constant uniform charge density ρ and the conduction electrons by a negative compressible fluid. The disturbance set up in the negative fluid by a fast charged particle was investigated and the retarding force acting on the particle was calculated. In 1947 Kramers (Physica 13, 401(1947)) attacked the problem anew, taking into account the discrete structure of the negative charge. It is noted that these theories are related to each other as hydrodynamics to a kinetic theory of fluids. Both theories may also be applied to the energy loss of a particle approaching a metal from the outside.

567 On the Fields Created by the Proton and by the Neutron. Louis de Broglie. Compt. rend. 229, 640-3 (1949) Oct. 3 (in French).

A new conception of the interactions between elementary particles and the photon and meson fields has been outlined in a previous article (Compt. rend. 229, 157, 269, and 401 (1949)). It is noted that this idea may be useful in the theory of nuclear forces. Interaction energies between protons and between neutrons and protons are calculated by a tentative method.

568 On Infinite Relativistic Particle Matrices. Walter Wessel. Phys. Rev. 76, 1512-19(1949) Nov. 15.

Besides the known tensors of integral and half-odd-integral rank (spinors) there exists a new form of relativistic covariant entities with an infinite number of components, discovered in 1944 by Dirac (Proc. Roy. Soc. (London) 183A, 284(1944)). An especially simple type of them is generated by operations underlying a theory of the electron recently proposed by the present author. This way the representations are obtained immediately in matrix form, the matrices being of an unexpectedly simple type. Half of them have continuous spectra. They permit the setting up of wave equations always having positive energy.

569 On Radiation Reactions in Collision Processes I. Ziro Koba and Sin-itirô Tomonaga. Progress Theoret. Phys. 3, 290-303(1948) July-Sept.

In order to reformulate Bethe's conclusions (Phys. Rev. 72, 339(1947)) the "self-consistent" subtraction method (Progress Theoret. Phys. 3, 211(1948)) has been applied to the elastic scattering of the electron. It is shown that the divergence, usually obtained when the reaction of the electromagnetic field of the electron is considered, can thus be eliminated; the method used is referred to as the "mass-type correction" to the scattering cross section. In addition, by means of a "polarization-type correction" to the scattering cross section, a further divergence is removed. This is done by interpreting the sum of the external potential and its infinite correction due to the vacuum polarization effect as a physically observable potential and substituting for it the actual value of the given potential. The interaction part of the Hamiltonian is supplemented by an additional "counter-vacuum-polarization" term. It is noted that the method used indicates an unambiguous method for obtaining a consistent and reasonable result with regard to the "infrared catastrophe," it is suggested that the result thus obtained will probably be close to the natural conclusion obtained by Bloch and Nordsieck (Phys. Rev. 52, 54(1937)).

570 On the Relativistic Interaction of Point Particles. W. Heitler. Proc. Roy. Irish Acad. 52A, 95-108(1949) Jan.

It has been shown by Heitler and Peng (Proc. Cambridge Phil. Soc. 38, 296(1942)) that the divergent terms occurring in the quantum theory of fields can be eliminated in a relativistically invariant manner. In this way a convergent but approximate theory of collision processes can be constructed. The interaction between two particles is considered in the light of this theory. Since the collision theory does not go over into the correct nonrelativistic theory, it cannot be considered completely satisfactory.

571 On the Wave Equations of Particles with Spin $h/4\pi$ and Their Solutions in the General Nuclear Fields. Gérard Petiau. J. phys. radium 10, 264-76(1949) Oct. (in French).

A study is made of the relativistic Dirac equations representing a particle of spin $1/2\ h/2\pi$ for the case that the particle is subject to a force field of the kind considered in the theory of nuclei, more general than the electromagnetic field, and acting on the particle through the intervention of the various characteristic quantities represented by the 16 matrix operators in the theory of the Dirac particle. After a discussion of the corresponding nonrelativistic approximations, particularly the nature of spin orbit coupling, the author examines in detail how the extension of the methods of Dirac and Darwin allows a solution of the wave equation

by separation of variables in the case of central interactions. In three remarkable cases, the existence of the first integral of Dirac makes it possible by an extension of a method of Temple to calculate the energy levels and to write explicit solutions in terms of combinations of radial and angular functions for interactions of constant strength.

572 Scattering of Pseudoscalar Charged Mesons by Nucleons. I. E. Corinaldesi and G. Field. Phil. Mag. 40, 1159-71(1949) Nov.

The cross section for the scattering of a pseudoscalar charged meson by a nucleon is evaluated by using the ordinary perturbation theory, and is expressed as a series of powers of the coupling constant. The first term of this expansion, proportional to g^4, is finite. The second term, proportional to g^6, contains sums over an infinite number of intermediate states and is divergent. These divergences are analyzed as nucleon and meson mass correction and mesonic charge correction. The subtraction of these terms follows the methods developed in electrodynamics. Finite corrections proportional to g^6 are evaluated for the case of mesons with momenta $p \ll \mu$. The fourth-order and sixth-order contributions to the cross section, $d\sigma_4$ and $d\sigma_6$, are evaluated and their ratio is given in terms of g.

573 The Statistical Theory of the Atom and Its Applications. P. Gombás. Vienna, Springer, 1949. 406p. (in German).

The first part of this book is devoted to the development of the general theory of the Fermi-Thomas statistical atom (including spin and relativistic corrections). The second part deals with applications: explanation of electron shells in the periodic system, theory of rare earths, calculation of the following: ionization and excitation energies, spectral terms, atomic and ionic radii, diamagnetic susceptibilities, polarizibilities, the scattering x-rays and electrons, the potential and electron distribution of heteropolar and homopolar molecules, lattice constants and energies, compressibilities of ions and crystals, and, finally, the properties of matter at high pressures. Numerical solutions of the Fermi-Thomas, and of the Fermi-Thomas-Dirac equations are given in tabulated form.

574 The Theory of the Dirac Electron in Momentum Space. Maurice Lévy. Compt. rend. 229, 985-7 (1949) Nov. 14 (in French).

The nonrelativistic theory of the electron in momentum space has already been treated by several authors (Weyl, Z. Physik 48, 1(1928); Elsasser, ibid 81, 332(1931); Fock, ibid 98, 145(1936)) but little work has been done on the relativistic theory. The Dirac equation for an electron in a coulomb potential is written in momentum space. Solutions are obtained by applying a Fourier transform to the solutions in Cartesian coordinates (Phys. Rev. 73, 1330(1948)). It is noted that the radial solutions correspond to spherical harmonics

in a type of five dimensional hyperspace, and that these solutions are, in this respect, similar to those of Fock for the nonrelativistic case. Other methods of solution are indicated. The results may be generalized to other types of central force fields.

575 Two-Component Wave Equations. J. Serpe. Phys. Rev. 76, 1538(1949) Nov. 15 (Letter to the editor).

Jehle (Phys. Rev. 75, 1609(1949)) has made a study of a simple type of two-component wave equation, involving a two-component wave function and its complex conjugate, and a real four-vector potential. Aspects of the relationship between such equations and the Dirac equation have been investigated by Kilmister (Phys. Rev. 76, 568(1949)). In the present article it is shown that Jehle's equation may be used to describe Majorana particles interacting with a scalar field. This formulation of Majorana's theory is then extended to the case where there is an interaction with a real scalar field and a real pseudoscalar field.

576 Wave Mechanics and the Study of Very Small Structures. Louis de Broglie. Ann. Telecommunications 4, 106-17(1949) Apr. (in French).

At the beginning of the Twentieth Century physicists confidently attacked the problem of the structure of matter, but soon found that great difficulties stood in the way of the proposed atomic models. It was necessary to introduce quantum mechanics, the principles of which are briefly outlined. Applications to the theory of light and to the motion of electrons are indicated. After a discussion of electron diffraction, the author explains the discrepancies between the results of diffraction experiments and the crude form of the theory. Applications to spectroscopy and chemistry are also discussed.

577 Vacuum Polarization in the Positron Theory. S. T. Ma. Phil. Mag. 40, 1112-28(1949) Nov. (See also NSA 2-2191).

According to the Tomonaga-Schwinger formalism, the induced current due to polarization of the vacuum may be expressed in terms of the potentials by means of an induction tensor. There is, however, some ambiguity in the evaluation of this tensor because of the presence of singular functions and divergent terms. Several methods of eliminating these ambiguities are noted. The paper gives an evaluation of the induction tensor along the lines of perturbation theory. In conclusion Pauli's regularization is applied to this tensor and it is seen that the results are unambiguous, covariant, divergence free, and gauge invariant.

578 The Wave Mechanics of Rigid Bodies. Andrée Goudot. Compt. rend 229, 646-7(1949) Oct. 3 (in French).

The article treats the motion of a rigid body with a fixed point. The constants of motion are expressed in Euler angles; the equations are transformed into operator equations, and it is then possible to determine their eigenvalues. These operations are indicated briefly, without detail.